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OR

**MILITARY ADMINISTRATION
IN WAR**

BY

**Colonel W. G. LINDSELL, D.S.O.,
C.B.E., M.C., p.s.c.,**

THIRD EDITION.

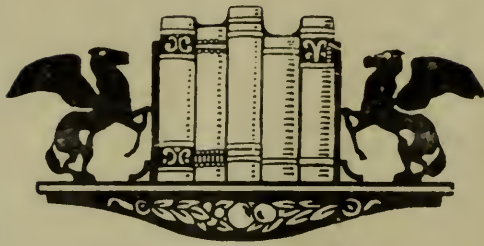
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OR
MILITARY ADMINISTRATION IN WAR

Military Organization and Administration

By

Colonel W. G. LINDSELL,
D.S.O., O.B.E., M.C., p.s.c.

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PREFACE

IN an earlier work, "Military Organization and Administration," the author has dealt with these subjects from a comparatively elementary point of view, both in their peace and war-time applications.

The object of the present book is to consider the question of military administration from a somewhat wider angle, and to discuss some of the broader principles of its practice in war.

The subject will be dealt with under the two main headings of Movement and Maintenance, for it is in the correct realization of the interdependence of these two functions, and their proper co-ordination in war, that success is to be obtained.

The increasing measure of mechanization which is gradually being applied to our Army brings all arms into closer contact with administrative problems than has ever been the case in the past. No officer who aspires to high command, or to employment on the Staff, can now content himself with a knowledge of his own branch of the Service alone; not only must he study the tactical employment of the different arms in combination, but he must have a working knowledge of the principles of movement and maintenance, the application of which alone makes possible the complete co-operation of all arms on the field of battle.

CHAPTER I

THE PRINCIPLES OF MILITARY ADMINISTRATION.

Historical Precedents.

IN his book, "Science of War," Colonel Henderson teaches us that war is firstly a matter of movement, secondly of supply, and thirdly of destruction. The teaching of military history amply justifies the truth of this statement, and even the most cursory study will show that our military plans must be administratively sound, or they are foredoomed to failure. This has always been true in the past, but it is doubly so now, and likely to become even more so in the future. The growth of the mechanical devices of war and the higher standard of equipment of modern armies have made the problems of maintenance many times more complicated than in any previous war in history. Strategy and tactics are now bound hand and foot by administration. The big problems of maintenance must be solved before a war can be brought to a successful conclusion; the side that fails to solve them will be defeated. The problems are no longer those of the soldier alone, nor even of the three fighting services; they are closely interwoven with the whole machinery of government and the entire economic life of the country.

In the good old days an army went off to war and lived on the country through which it moved, and frequently exterminated its enemy entirely, as one means of simplifying the supply problem. Later, armies dragged fairly considerable supply columns along with them to carry their needs for the period of the campaign, or established a number of field depots from which they could operate for certain periods. In small wars, in certain countries, this system may to some extent still

meet our requirements. Modern war, however, of the continental type can no longer be waged on these lines.

In a Boer war, in a war on the North-West Frontier of India, in an East African campaign against von Lettow, hostilities may be dragged out for long periods, as the enemy has little or no essential line of communication, no vital source of supply, which can be interrupted ; but in a modern European war the rear organization of a nation in arms is so elaborate and so indispensable that a successful blow at an enemy's maintenance system will yield far quicker and more decisive results than anything known in previous wars. Men and horses can fight for a short time without food or on restricted rations, but the internal combustion engine will not run a yard without fuel.

What brought the German advance in 1914 to a standstill ? Maintenance failure—failure to maintain the supply of men, horses and ammunition, which were available in Germany, but could not be delivered—the German army outran its maintenance possibilities.

What prevented the relief of Kut ? Was it not the impossibility at that time of maintaining a sufficiently strong relieving force at the end of an undeveloped line of communication ?

The Russian Second Army, in 1914, was beaten before it ever reached Tannenberg, because it was starved.

What caused the eventual crash of the German nation in arms ? Was it the victories of Foch, or the blockade established by the British Navy ?

After the Armistice in November, 1918, why did not a victorious allied army advance in its full strength to, and across, the Rhine to dictate terms of peace in Berlin, as the Prussians did in Paris in 1871 ? Because such an army could not have been maintained during its advance. It was with the utmost difficulty that the force that did go forward was fed until the railway system could be reconstructed behind it.

It is in a consideration of these broad administrative facts that the big lessons of the Great War are to be

found. The problems concern not only the fighting man, but the statesman and the Government, including the Governments of the Dominions. There is no hard-and-fast line between the soldier's task and the statesman's, nor are the problems confined to the administrative branches alone; the big questions of movement and maintenance are intimately bound up in every military problem, whatever its nature. In consequence, we now read in Volume I of our Field Service Regulations:—"The provision at the right time and place of the vast quantities of material of varied natures required by an army in the field and their transport are frequently the deciding factors in the success or failure of its operations." The chief purpose of this book is to examine the broad principles both of movement and maintenance, the observance of which alone makes it possible for an army to carry out the plan of its commander and to give effect to the policy of our Government in time of war.

It has been pointed out above that military administration is not an academic subject to be studied separately from the operational problems of strategy and tactics; on the contrary, it is a first principle of administration that each problem that presents itself must be tackled in the light of its effect on the attainment of the ultimate object. Administration is the servant of tactics and strategy, but such an important servant that it cannot afford to be ignored. "What is the good of issuing orders unless they are feasible? Can the distance be covered within the space of time allotted; will the roads and railways bear the increased weight of traffic demanded? When the troops have reached the desired spots, can they be maintained there in ammunition, food and clothing?"* These questions must be considered, but, within the limits of possibility, administration must meet the tactical requirements of each particular case.

Although the interdependence of strategy, tactics,

* "Tannenberg . . ." Sir Edmund Ironside.

and administration is clear, it is also a principle that there must be a separation between Command and Administration. Command and all it stands for—the higher training and education of troops, plans of campaign, scientific organization and preparation for war: in a word, military Art and military Science—would wilt and wither in an atmosphere supercharged with administration. The commander must be relieved of all detail work of an administrative nature. The greater responsibility, therefore, is thrown upon those whose duty it is to carry out the administrative work. Though military operations and military administration must work hand-in-hand, it will sometimes happen that administrative means are not commensurate with strategical and tactical aims. Real knowledge is required of the officer if he is to be in a position to say whether a certain operation is feasible or not on technical administrative grounds. It requires clear thinking, and careful calculations based on the knowledge of capabilities and limitations of units and services, to enable a correct conclusion to be formed.

The next broad principle of military administration is to be found in the division of the subject into its two main branches of movement and maintenance. Though these two are complementary the one to the other, yet in the higher organization of the Army they require separate sub-branches of the staff to deal with them, under the general co-ordinating direction of the Quartermaster-General in the field.

Under the general heading of maintenance come all questions regarding the provision and supply of food, water, ammunition, petrol and military stores of all kinds, questions of quartering and accommodation, the provision of remounts and the maintenance of material reserves of equipment and stores, problems of salvage and evacuation of stores no longer required by the fighting troops, the repair and upkeep of war matériel, the general welfare of the troops, their messing, institutes, baths and laundries.

Under the heading of movement all problems of organization and upkeep of transport by road, rail, inland water, sea, or air, and their co-ordination are dealt with; also embarkations, disembarkations, entrainments and movement of troops by mechanical transport, and the organization of special natures of transport to meet particular conditions of climate or country whenever encountered. Under this head, too, come all the wider questions of transportation which arise in connection with the organization and working of docks through which our fighting troops and their maintenance requirements must pass in war.

When an expeditionary force leaves this country for war, the administrative duties which have to be performed in connection with its movement and maintenance are divided into three zones of responsibility. In so far as these duties are the responsibility of subordinate commanders, in meeting the immediate requirements of units it is the zone of local administration. The next zone is that of general administration, which is directly controlled by G.H.Q. In this zone through movements of men, animals and stores are dealt with; while in the sphere of maintenance, questions concerning the general reserves of supplies, ammunition, engineer stores, and the larger workshop and repair installations are decided. The administration of docks, bases, railways and local sea transport, and all questions of transportation are also subjects of general administration. Finally, there is administration by the Army Council, where the broad questions of policy are determined, scales of reserves to be maintained in the various theatres of operations are laid down, and arrangements are made for the bulk provision of all the material needs of the army.

There is no exact line of demarcation between the three zones; the boundary in each case is an elastic one, as co-ordination throughout, especially as regards movement is essential. But this division of

responsibility is, in a general sense, a first principle of sound military administration.

We find another application of this last principle in the system of administration by areas. Under this system the area occupied by a formation is controlled by the commander of that formation, and he is responsible for all questions of local administration in that area. In conformity with this principle, the whole theatre of war is divided into areas and sub-areas for purposes of military administrative control, both on the lines of communication and in the regions occupied by the fighting formations.

During mobile operations the boundaries of these areas may be constantly changing, but care is necessary to ensure that the boundaries are always clearly defined ; they must be drawn so as to ensure, as far as possible, that all towns, roads, villages, depots and all military installations are definitely on one side of them or the other.

Changes in the boundaries of administrative areas are to be avoided as far as possible, as such changes are likely to involve expenditure of labour and money, and they may seriously affect the smooth working of administrative arrangements.

The principles outlined above may be traced throughout the whole system of maintenance and movement of an army in the field. These systems will be examined in the chapters which follow.

CHAPTER II

MOVEMENT.

Section 1. General Principles and Organization of Military Movement.

MOVEMENT is a first principle of war organization, for unless a weapon or a force can be moved it cannot develop its full power. In the realm of strategy movement by sea and railway is a governing factor in the assembly and grouping of armies, and in their maintenance. The use of railways and ships in war admits of rapid changes in the direction of our lines of supply, and makes possible the exploitation of the most distant sources for the provision of our essential war matériel. During the Great War twenty-five and a half million tons of stores were shipped to France alone, for the use of the British Expeditionary Force. Correspondingly vast shipments were made to other theatres of operations, and in addition very large quantities of material, such as road stone, coal and timber, were obtained locally.

The object of this chapter is to examine the broad principles upon which the movement of this enormous mass of materials depends. Men without weapons and food, guns without ammunition, tanks without petrol, are useless encumbrances to an army in the field. It is movement alone that can ensure the correct combination of all these items, whether men or munitions, at the right time and place to bring about the defeat of the enemy.

In the solution of our tactical problems we are taught to consider the combination of fire and movement—the use of fire to produce movement—but this is the fire of guns, machine guns, rifles and aeroplanes in combination with the movement of the fighting man.

There is still another aspect of this combination to be considered: put the fire under the boilers of your ships and steam engines, or in the cylinders of your internal combustion engines, and combine it with the vast mass of men and material that modern war requires, and you will have a series of the most interesting problems of movement that it is possible to produce. This is the aspect of the problem that we now have to consider, for an understanding of the principles upon which it is based is of vital importance for the successful conduct of modern war. Whenever these principles are overlooked or neglected trouble arises. The report of the Commission which inquired into the Mesopotamian campaign gives ample proof of this. But it was the same in other theatres—a great deal of our troubles in the later stages of the Great War in France were due to neglect of these principles in the early stages of 1914, and in many cases we never, in the whole course of the war, got over the difficulties we had created for ourselves at the beginning by neglect of first principles of transportation.

Movement is no longer represented by mere muscular power on the field of battle. Machine power is replacing muscular power, and every day the problems involved become more interesting. Military history teaches us the necessity for studying the problems involved. In the Franco-German War of 1870, even in the 1866 campaign against Austria, the use of railways by the Prussians played a very important part in their military plans, while in the Russo-Japanese War, and in the South African War railways became a vital necessity for the maintenance of the forces in the field. No force can go to war from this country without the use of movement by sea; roads, too, play an enormously important part in all military operations. The historical methods of movement by means of railways and roads remain with us, and cross-country mechanical movement must now be superimposed on our strategical conceptions.

There are two outstanding lessons of military history in connection with movement. They are :—

- (a) That modern operations are dependent on railways or on some approximate equivalent to railways where they do not exist.
- (b) That a form of military control is necessary over such railways.

With the exception of the Trans-Siberian Railway in the Russo-Japanese War, when strain was felt, railways, prior to the Great War, were capable of carrying out military demands without undue strain. Even so, military control was found to be necessary ; it is more than ever necessary to-day. In consequence, we have in our service a Transportation Directorate which functions, generally speaking, from ship side to railhead in an overseas theatre, whereas the actual chain of movement stretches from the Home Country to the front line, and includes sea, rail, inland water, and road transport of all natures, or any combination of them, or in any order.

This whole chain is a Q.M.G. service, the responsibility being divided between the Q.M.G. at the War Office as far as the overseas base port, and the D.Q.M.G. in the field from base port to front line.

To get the correct picture we should regard movement of anything, man or material, as one whole and continuous operation from its beginning, say, in England to its final destination in the front line ; we should go farther than that, and regard the return movement of the ship, train, barge, lorry or wagon which has carried the article in question, as part of the same continuous and unbroken chain of movement from start to finish. The reason for this is that the most efficient use of a movement system is when it is running full, regularly, and at the greatest speed of which it is capable.

The underlying principle, which applies to every link in the movement chain, is *quick* “*turn-round*” ; that

is, quick loading, rapid dispatch, swift unloading and prompt return for the next load.

In our army, as stated above, movement is a Q.M.G. Service ; That is, its control is primarily vested in the Quartermaster-General. In other armies it is dealt with by a separate branch. The point to remember, however, is that movement is intimately bound up in every military problem in one form or another. Its problems cannot be confined to one branch of the Staff alone. Even before the war starts, when plans of campaign are being prepared, you must consider such questions as the following :—

- (a) What are the transportation facilities of the theatre of war, and are we equipped to use them ? Consider, for example, what differences would be necessary in our organization for a war in China, in Iraq, on the North-West Frontier of India, in Egypt or in Western Europe.
- (b) Are there suitable ports for use as a base for personnel and matériel ? Has our expeditionary force got to land at a fully equipped port like Southampton or Havre, or has it got to get ashore on an open beach as at Gallipoli, or at an ill-equipped port such as Basra was at the beginning of the Great War ?
- (c) What railways exist, and what rolling stock ? Must we ship railway rolling stock overseas as we did between 1914 and 1918 ?
- (d) What inland waterways are there ? Shall we take the Thames' steamers and barges with us to maintain our lines of communication on a Tigris or a Nile ?
- (e) What roads are there, and what class of road transport can be used on them ? Shall we require heavy lorries, or light six-wheelers, or must we use pack mules, camels, or porters ?

All these must be taken into account when making our plan of campaign.

Go one step farther than the plan of campaign and it will be found that, from an administrative point of view, the organization of the base area is primarily one of movement. It is impossible for Staff or Services concerned in base organization to get a correct view of the problem unless they realize the very important part played by movement in its solution.

Thousands of tons of stores arriving at the base ports have got to be moved through these ports and delivered to the fighting man ; this is in addition to the movement of the actual troops and their transport.

The next point to bear in mind in connection with movement is that the various agencies concerned in it, railways, shipping, docks, inland water transport and so on, are really very delicate machines. They require highly technical and skilled management to get the full output from them. With unskilled handling the capacity of a railway, for example, falls off enormously, and if certain technical considerations are not given sufficient attention, you may quite easily break down the system or reduce it to impotence by hopeless congestion.

The existing peace-time technical organization may not be available in war, and a modern army must therefore include the technical personnel for the proper working of its movement organizations. While the soldier, who has to use these various means of movement, must appreciate the importance of technical considerations and make due allowance for them.

In China it has been a common occurrence for a railway line to be completely blocked by the mass of troop trains that have been run over it. The railway staffs have been helpless, as the military commanders have insisted on trains being run quite regardless of traffic regulations. Trains were dispatched with utter disregard of there being room for them in sidings or

not. They were often left standing on the main line itself, while the engines broke down owing to their being kept continually under steam. We are not likely to imitate the Chinese, but if we neglect the principles of transportation we shall certainly produce congestion and delay in our movement systems if not breakdown.

In consequence our army in the field is now provided with the necessary technical machinery in the form of transportation units of various sorts for working railways, docks, inland water transport, etc., and these units are just as essential to a modern army as tanks, aeroplanes or machine guns. In war, however, we cannot leave the entire running of our transportation agencies in the hands of the technical experts. The administrative transportation agency is the servant of tactics and strategy. The fighting soldier is not required to be a technical expert, but he must be in a position to appreciate the technical point of view, and know how best to use the technical knowledge and skill of the expert. It is here that the staff officer concerned with movement must play his part. Let us take an example to illustrate this point more fully :—

The Transportation Service will produce, say, a railhead scheme, their plans will be actuated mainly by technical considerations. The responsibility for acceptance or amendment of the scheme lies with the Staff. The Staff, having a broader view than the service of transportation alone, must take into consideration other factors, such, for example, as :—

- (a) Are the railheads well situated from an air defence point of view ?
- (b) Are they sufficiently far back to be reasonably safe from enemy ground action—*e.g.*, tank, armoured car or cavalry raid. If a breakthrough occurred, would it be reasonable to hope for re-establishment of the front, or re-stabilization, before railheads have to be abandoned ? Because it is dangerous to

have to change any railhead in the course of an action.

- (c) Are they far enough forward to allow for secure supply if we advance ?
- (d) Do the railheads selected demand so much engineer work (railway construction, road and yard making, etc.) that the Transportation or Works Service will be overburdened and have to be relieved from other important work ?
- (e) Their situation affects the road traffic problem. Are the locations suitable from this point of view ?

These and similar problems will have to be decided by the Staff in consultation with the services concerned. Only railways have been mentioned, but it is the same with docks, inland water transport or any other transportation agency, and the Staff must know about these questions to enable them to compete successfully with their share of the problem.

Thus we arrive at a double-branched system for the control and operation of transportation in the field : the staff side and the technical side, the whole being controlled by the D.Q.M.G., who has an A.Q.M.G. to assist him on the staff side and a D.G.(Tn.) on the technical side. Under these two officers is a joint organization known as the *Movement Control*, consisting of both staff and technical officers who carry out the actual detail work of co-ordination and direction of all movement between the docks and railheads throughout the theatre of war. Outside the *Movement Control* organization, but under the D.G. (Tn.), are the technical directors of the movement agencies such as docks, railways, inland water transport and light railways, who are concerned with the purely technical aspects of construction and operation of their particular agencies. Similarly, under the A.Q.M.G. arise certain staff duties of co-ordination between the line of communication movement and

distributory movement in advance of railheads which do not come within the scope of hour to hour and day to day control carried out by the *Movement Control*.

For smooth and efficient working we first of all want regularity—regularity of demand producing regularity of output. Any variation must tend to upset the normal working of the system. In war, however, variation cannot be avoided. It is by variation that the commander hopes to obtain surprise. Some contemplated operation causes an abnormal demand for the time being, action by the enemy may call for sudden and unexpected variation, the weather may interfere with the regularity of oversea communication, frost or floods, snow or thaw, may easily cause serious interruptions, upsetting, for the time being, the carrying capacity of one or more links in our transportation chain.

In war variation is always occurring, and it is the enemy of efficient working. The duty of the Movement Staff is to compete with this difficulty to foresee the sudden changes and to be prepared to meet them—foresight, ingenuity, improvisation and unremitting energy are required from all officers of the Movement Staff.

In a small war, possibly also in a great, phases of active operations imposing abnormal demands on the transportation service are likely to be of comparatively short duration. If they can be foreseen well ahead, it should be possible to build up reserves of material sufficient to meet abnormal requirements, and so avoid fluctuation in the demand for special categories of stores from the base. Cases will nevertheless occur when unforeseen strain will be imposed on the transport services, and it will then become the duty of the Staff to decide on a priority of dispatch of material.

Movement as a whole is controlled by the Staff, but this control is an elastic one ; at times rigid and amounting to “command” ; at others, intangible almost as in traffic control of road transport, or the routing of individual ships at sea.

Sea transport and road transport are by nature extremely flexible ; railways and inland water transport are exactly the reverse. The less flexible the means of transportation, the tighter and more rigid must be the control. You cannot allow any "monkeying" with a railway system to meet the wishes, or even prayers, of individuals, because it goes against every principle of sound operation and sooner or later brings about congestion and breakdown. Here, then, you have the maximum of rigidity and the maximum of centralized control. For the individual ship at sea, or lorry on the road, it may often happen that, within limits, one way is as good as another. Much can be left to the ship's captain or the lorry driver ; the system is flexible, the control elastic.

To get the best results we want to ensure a steady well-balanced flow of commodities through each link in our chain of movement, no one link being overloaded. The reinforcement of one echelon in the chain of supply may throw an undue strain on the next ; reinforcement at one stage calls for a corresponding reinforcement in the other links. The Staff must always be watching for any factor tending to upset the balance and in conjunction with their technical advisers must take steps to put the trouble right.

The most probable places for trouble to arise are at the points of contact of the various transport agencies, such as docks, loading points, railheads, refilling points or transfer points. Here, with two or more agencies meeting, you may get conflict of interests and possible interference with operation. Interference may be caused by enemy action, bombing or artillery fire, or it may be due to bad staff work, such as failure to provide sufficient labour, neglect of traffic control, or lack of appreciation of the evil results likely to arise from a certain course of action. The Staff must put the matter right, and they must put it right quickly, or the trouble may easily get out of hand.

Pressure will often be exercised to obtain a relaxation

of rules which are based on sound movement principles. Such pressure may be exerted by individuals who seek to alter timings to meet their particular requirements, or who ask for special consideration to facilitate the working of their own service. For instance, there may be pressure to relax the sound rule which forbids the formation of depots in dock areas or further forward in railway station yards. The Staff must consider each case on its merits, in conjunction with the advice of the experts, making due allowance of course for the possibly one-sided outlook of the technical expert, and decide what is to be done. But do not give way on a question of principle unless you are faced with an emergency the gravity of which justifies the serious consequences which are likely to arise.

The policy as regards movement must be dictated by the operational requirements necessary to give effect to the commander's plan. It will, however, sometimes happen that operational requirements are at variance with working on sound movement principles. For example, the piling up of fighting formations as reinforcements in Mesopotamia, when the available transport was already inadequate to maintain the troops which were there, only added to the difficulties of the situation, and made the relief of Kut all the more impossible. In such cases it is the duty of the Movement Staff to point out the effect on movement likely to result from the proposed operational policy. If adjustment cannot be effected in consultation between the branches of the Staff concerned, appeal to the commander is the only solution, but with a good Staff this should rarely if ever be necessary.

This possible difficulty might be overcome by making Movements a branch of General Staff work instead of a "Q" responsibility, but as the things which put the greatest strain on movement facilities (things such as supplies, ammunition and maintenance stores) are matters which are the special province of the Q.M.G.'s

department, it seems more logical for movement control to be vested in "Q."

The necessity for regarding movement as a whole from start to finish, for the complete turn-round of the modes of conveyance, has already been referred to. For smooth working, and in order to avoid congestion at any stage, continuity and regularity of movement are essential; to obtain this, centralized control is a *sine qua non*. In consequence, the Movement Staff must be part of the G.H.Q. Staff, and this is the organization in our army.

With these preliminaries the principles which are applicable to any transportation system may now be summarized as follows:—

- (a) The capacity of the whole system should be approximately the same from end to end.
- (b) The facilities at the terminal points and transfer points, such, for example, as docks or rail-heads, should be sufficient to ensure a rapid turn-round of the carrying vehicle.
- (c) The means of transport should be kept continually in motion and loaded to their full economical capacity.
- (d) Movements should be balanced in both directions.

These principles may sound academic, but a few moments' thought on their application to particular cases will show their truth.

Imagine, for example, ships continuing to discharge in a dock more rapidly than rail, road or other transportation agencies can remove the goods, and it is clear your dock will soon be so congested that further unloading of ships would become impossible. Or again, if forward movements are not balanced by movements in the opposite direction, you would soon find all your available railway wagons, or lorries, or other means of conveyance collected at one end of the line while none were available for reloading at the starting point.

This appears obvious in print, but the principle was in fact often neglected during the Great War, with results tending, had not drastic steps been taken, in the direction indicated. *The secret of success lies in regulation of despatches.*

Section 2. Technical Organization for Movement.

In the previous section the general system for the organization of movement into a staff side and a technical side has been outlined. The *raison d'être* and functions of the technical side will now be considered in further detail.

In most theatres where war is possible, and certainly in Europe, we shall have to develop and employ every means of transportation possible. We shall have railways, light railways, docks, roads and inland water transport. Each of these has its own special technical characteristics as regards survey, construction, maintenance and operation. Each again employs its own types of skilled tradesmen of innumerable grades for construction, operation, mechanical engineering, conservancy, buoyage, pilotage, marine engineering, and so on. Though all the various means of transportation in war will be working to the same end—namely, to deliver the goods to the fighting man, they work each under their own technical head, and to get the best value from our transportation system as a whole we must have a co-ordinating technical authority.

It might be asked, why cannot this co-ordination be done by the Movement Staff under general direction of the Q.M.G. ? The Staff is responsible for the general movement policy, could they not also ensure that each transportation agency works technically in close co-operation with the rest of the group ? This plan would not be a sound one, because the questions involved are frequently of a highly technical character, and although technical knowledge is most desirable in the staff officer, in the nature of things it cannot normally be great or sufficiently widespread. The necessity for

a co-ordinating technical authority will, perhaps, be made clearer by considering some cases in which such an authority would be required to act in practice.

Take first a case where two services meet and competition arises for the use of some plant common to both. Such a case occurs in connection with a railway service inside a dock area, the operation of which must closely affect the Docks Directorate on the one hand, and the Railway Directorate proper outside the dock area on the other; similarly, lighter work inside the dock area affects both Docks Directorate and Inland Water Transport Directorate. Or again, the operation of a swing bridge or similar installation which, when shut, blocks, say, the inland water transport, but allows railway or road traffic to proceed, and which, when open allows inland water transport traffic and blocks railway or roads. Even level crossings on important traffic routes may require special treatment.

Questions, such as those just mentioned, of traffic movement inside docks, or the hours of opening of swing bridges, are more likely to be technical questions, depending on factors such as railway timings and tides, than to be questions of general movement policy and they are therefore better left in the hands of the co-ordinating technical authority.

At times, however, questions of policy may arise as when tactical considerations require a bridge to be kept open for the passage of troops—in such cases it is clearly the province of the Staff to impose a decision which must be accepted by the transportation authority.

Another type of case may arise wherein there is a conflict of interests calling for decision by the technical authority. For instance, after an enemy's bombing attack, urgent demands from two services might be received simultaneously for specialized lifting gear to deal with separate breakdowns. The Director of Transportation has then to decide which is the more important to clear first, and he allocates plant accordingly. Take another case. Suppose coal supplies are

temporarily restricted from any cause. Which service is to have its demands most nearly met? Coal for tugs—*i.e.*, the Inland Water Transport Directorate; coal for railway engines—*i.e.*, the Railway Directorate; or coal for steam cranes—*i.e.*, the Docks Directorate. How much of the whole transportation allotment is to go to each? Will it be more economical temporarily to reduce railway traffic and increase inland water transport? These are all technical points, and they require decisions from a technical authority rather than from the Staff.

Yet another occasion for the exercise of the co-ordinating authority of the technical head arises from the variation of the Army's demands from time to time on the service of transportation. During quiet periods, apart from the duty of building up reserves, one must try to withdraw into technical reserve as much as possible of the technical plant and personnel, so as to be ready for the big effort which is certain to be demanded later. Who can decide what goes into reserve? Clearly not the head of any one service, for it is only human nature to conserve one's own show against the day of need at the expense of the other man's. These are points of *technical* policy to be decided by the *technical* head—the Director of Transportation.

It is inadvisable to take one of the directors—say, of railways—and make him also the co-ordinating authority for the lot, because with all possible goodwill he cannot fail to look at the problems of the other branches otherwise than through the tinted spectacles of his own particular line of business; and with the financial responsibility, which such a position carries under our existing regulations, any one man would be unduly burdened in undertaking the dual rôle. Consequently in our existing War Establishments a Transportation Directorate is allowed for, with a Director of Transportation at its head or, if large

forces are concerned, we have a Director-General of Transportation.

It is hoped that the relative functions of the two distinct sides of movement organization—the staff side and the technical side—have now been made clear. It is very necessary for soldiers to appreciate this organization correctly, because when our army expands to a war footing, the officers who will fill these technical posts will be drawn to some extent from civilian sources ; though they will be great experts in their own line of business, their military knowledge may be limited. It is therefore necessary for the soldier to have sufficient knowledge of the technicalities involved so that, while not attempting to force impossible demands on the technical service, he may not be imposed on by the highly coloured representations of the technical expert.

Section 3. Application of the Principles of Movement.

Having considered the main principles upon which our war-time movement organization is based, we will pass now to the application of those principles to the lines of communication of an army in the field, taking the case of an army operating overseas and receiving all its needs, whether personnel or matériel, through one or more base ports.

First of all, let us try to picture to ourselves what the term “lines of communication” really means. One sees, I think, ships on the sea converging on a point, a base port, thence a railway or river leading into the interior, and then a road going forward from rail or river head, eventually reaching the soldiers in the front line ; the whole conception is linear. Do not forget, however, that it is not the line of Euclid, which, as will be remembered, has length without breadth, for our lines of communication have considerable breadth ; they are areas, not lines. This is the first point to get hold of—that the L. of C. is an area, which has to be divided by its commander into sub-areas in accordance

with the various activities carried on in different parts of it.

Thus, if we imagine a L. of C. starting at Southampton and running to London, we might have a Southampton Dock sub-area—an Eastleigh Base depot area—a Netley Hospital sub-area—a Hindhead Convalescent sub-area—a Farnborough R.A.F. sub-area, and so on according to our requirements; and our movement system would be intimately connected with all this organization. The whole conception of our lines of communication must be one of movement.

The next mental picture to get hold of is the enormous amount of movement that is continually going on in the L. of C. area. In addition to train-loads of ammunition, the daily supply pack trains, ambulance trains, and leave-trains, there will be train-loads of bulk stores, such as timber, R.E. material, road stone, coal and similar commodities, trains of remounts or of sick horses going to and from the front. For everything that goes forward there should be a corresponding movement towards the rear. Then, again, there is continual cross movement between depots, regulating stations, and railheads, and from hospitals, and remount depots to convalescent depots for men and animals. Superimposed upon this you may have considerable strategical movement of troops. Then there are reinforcements to go forward, damaged guns and stores to come back for repair and their replacements to go up to the front. You cannot live from hand to mouth; in addition to your daily requirements, you must build up reserves behind your fighting formations as they advance. This all means movement. All will have read of the wonderful development by the Germans before the war of their strategical railway system. They started the war with sixteen railway tracks across the Rhine; they ended it with twenty-six, an increase of sixty-two per cent., which was still barely adequate to meet their maintenance requirements.

All this sort of thing is quite obvious when one stops

to think about it, but its application in war is very apt to be overlooked. When plans are being made to launch armies into the heart of China, Russia, Iraq or Afghanistan, this movement picture must be kept in mind, or these same armies will starve at the ends of precarious single lines of railway, or they will be compelled to surrender to the enemy as in the case of Kut.

Having painted the general picture, let us now consider how the mass of men and matériel arriving at our overseas base ports is dealt with there and subsequently sent forward to the front.

The case of an opposed landing, which is a tactical operation, is not under consideration in this case, but a landing in our own territory or in the country of an ally, which is not liable to be interfered with by any action of the enemy's ground forces, though the possibility of attack from the air cannot be left out of consideration.

Movement of Personnel.

The manner of dealing with troops when landing overseas and moving to a concentration area is normally as follows :—

- (i) All troops will move from landing quay into reception camps by march route.
- (ii) Troops remain in the reception camps from twelve to twenty-four hours for purposes of :
 - (a) Medical services ;
 - (b) Separating out details to remain at the base, such as first reinforcements ;
 - (c) Completing any deficiencies in equipment.
- (iii) Troops are moved to the concentration area normally by rail, but possibly by march route.

That is, in brief outline, the normal method of dealing with personnel. The methods of moving troops by rail in strategical or tactical trains will be dealt with

in a later chapter. We will now consider the methods of dealing with stores and material of all kinds.

Movement of Stores.

Our ship-loads of material arrive in the docks and here they are dealt with in one of two ways :—

- (a) *Normally* by transportation service alone direct from ship side to base depot, thence by “pack” or “bulk” train to railhead by mutual arrangement between transportation and the service concerned; by service concerned is meant the supply, ordnance or other service.
- (b) In special circumstances direct from docks to railhead after request by the service concerned.

The movement staff is concerned in case (a) only in general supervision; the consignee service is not concerned at all until the goods arrive at base depot. The movement is a transportation routine matter. In case (b), which is contrary to certain principles which will be returned to later, justification for the demand is required from the holder to the movement staff. It will be observed that the goods go direct from ship side to base depot or, in special cases, to railhead; they do not go into warehouses in the docks area. In this respect the practice of war differs from that of peace. In the Port of London, and in fact in practically any commercial port throughout the world, a very large part of the business consists in warehousing, and from this source the bulk of the revenue of the port authority is derived.

Space in the immediate vicinity of the actual docks is utilized to build warehouses, the floor space in which is let out to merchants, and there they store their goods pending marketing. As the commercial prosperity of the port increases all available space for expansion is taken up and the necessity arises for a new dock else-

where—thus Bristol throws off an Avonmouth and the Tyne constructs a North and South Shields, mainly because there was insufficient space at the parent port to deal with the increased volume of traffic. This state of affairs comes about slowly in peace time, and the majority of ports about the world are quite stationary in this respect and are able to compete with the normal commercial activities of the areas they serve. But subject any one of these ports to the enormous development necessary for the base port of an army, and it becomes obvious that no warehousing at all is possible in the dock areas, or congestion will at once arise. So you arrive at this *first principle* of military transportation :—

Allow no warehousing—i.e., no depots in the dock area. This is a principle that was very largely neglected when the British Expeditionary Force first landed in France in 1914, and this neglect very nearly caused a breakdown in our maintenance system later in the war ; the reason being that, in 1914, there was a tendency to utilize space inside the dock areas for warehousing military stores, or in other words, for base depot purposes. This soon caused serious congestion in the ports, and prevented the unloading of subsequent consignments of goods.

We now know that the use of an ordinary commercial port as a military base port will demand such an extension of dock railway facilities that it may even become necessary, if warehouse buildings exist inside the dock area, to pull them down and remove them altogether in order to make room for the necessary railway expansion. This, of course, does not refer to the transit sheds which are an essential link in the clearance facilities of a port, and the worst crime of all is to make a depot in a transit shed.

It should be remembered that no port is ideal for military purposes, and that every commercial port has its own class of trade and its distinctive method of handling it. For military purposes the class of trade may have to be altered. Any alteration in the class of

goods to be sent through a port cannot be made until a very careful examination has been carried out of the port facilities to handle such goods, and an appreciation gained of the capabilities of those facilities to deal with goods which the port has probably not been designed to handle. For example, a wheat port fully equipped with suction grain elevators may not be suitable for landing heavy mechanical transport, and ports which normally handle passenger traffic in the main, are rarely provided with lifting appliances for heavy weights.

In dealing with questions of dock development for military purposes, it is important to bear in mind that docks in themselves are not, strictly speaking, a movement agency any more than a refilling point is. They are simply a transit point between two agencies operating on sea and land respectively. The essential of dock working is movement; as fast as goods arrive in the dock they must be removed outside the dock area. Any development of dock capacity must therefore have a corresponding development of the transport agencies—rail, road or inland water transport—to remove the goods arriving in the dock. It is useless to develop a dock beyond the capacity of the removal facilities adjoining it. And this is *another principle* of transportation. *The operation of military docks is for transit and transit only.*

Dock work is dependent on harmonious operation with two other services—sea transport and railways. The problem is to keep the balance right, so that no more and no less is brought into a dock area by either agency than can be handled in transit by the docks service and by the other agency in clearing the dock area.

It was on account of this that it was found necessary in the Great War for all demands, emanating from the army in the field, for the shipment of stores from the Home base to be co-ordinated by one authority. This co-ordinating authority was vested in the man who was in the best position to know that quantities of

stores of different natures could be received and handled in the docks on any given date, that is to say, the Director of Docks. The system was accordingly introduced of sending one telegram daily to the Home authorities stating the natures and quantities of the stores, required by each one of the different services, to be shipped overseas for arrival on any particular date. This telegram—agreed to by the services concerned—was sent by the Director of Docks, and by this means dock congestion and consequent delays were reduced to a minimum.

A similar problem arose at the shipment end, where it was found that, unless control was exercised from the docks, goods would arrive in the dock area by rail from the various factories throughout the kingdom in the wrong order for loading in the ships. This gave rise to considerable railway congestion inside the dock area, and seriously delayed the actual loading of ships. So a system was enforced of notifying the port when stores were ready for shipment, the actual stores remaining in the factories until called forward by the Director of Docks. By this means it was found possible to arrange for the stores to arrive alongside the ships in a convenient order for stowing, and this resulted in very much increased speed in the loading and dispatch of goods and a great reduction in the time which ships were required to spend in harbour. It will be observed that this is nothing more than the application of the four principles of movement as summarized at the end of Section 1.

Bearing these principles in mind, it will be easier to understand why a system has been adopted which necessitates two separate journeys and handlings for each ton of material landed at a base port. One trip from dock to the depot and another from the depot to railhead. Why are the stores not sent straight from the docks to railhead? This double system is admittedly costly in labour, but there are material advantages in its adoption as a standard practice.

Whenever any attempt is made to rail direct from quay to railhead you invite the evil of congestion. Once started, the cure is difficult and sometimes almost impossible without stopping down imports to a dangerous degree. Furthermore, the average flow to the troops in war has been proved to be less. This is due to many causes, but perhaps chiefly to the restriction of elbow room for satisfactory rail working in the dock area.

Whatever the cause, this lesson emerges :—

- (a) That interference with the free movement of material out of the dock area must be reduced to the minimum.
- (b) That this reduction is certainly best secured by leaving this movement to the Transportation Service, whose sole interest is rapid movement. This means that the services (supply, ordnance, etc.) should take an active part in handling their material only after its arrival in the depot.

Causes may arise which make it imperative to avoid the delay in and out of depot in respect of certain specific lots of material. When this happens the service concerned must put the case to the Movement Staff, but in practice instructions for such action will always emanate from superior authority at G.H.Q. Examples of this might be a consignment of special fittings for say, tanks or aeroplanes, or a special type of ammunition required in connection with some operation contemplated for an early date.

It should be noted that, from the point of view of the service concerned, there is a great danger of delay in despatch of any direct consignment from dock to railhead if :—

- (a) The consignment is part of a miscellaneous cargo ; or
- (b) Is composed of different articles which may perhaps not be loaded in one hold of a certain ship ;

- (c) It requires any turning over, or sorting, of material already landed on quays or in transit sheds in docks.

Under the normal system there is an additional advantage in that any cargo can come to any port or any berth in that port with the moral certainty that, no matter how they are loaded, stores collected from any such cargoes for a particular service will arrive at the appropriate depot, where sorting out can be carried on expeditiously by the service concerned.

This simplifies the loading problem at home, permits homogeneous cargoes of any size to be shipped from any port at home or abroad direct to the base port in the theatre of war, ensures greater safety of valuable cargoes by letting ships get inside harbour, protection more quickly, and results in a general speeding-up of tonnage deliveries.

Take ammunition as an example. The shell may be made in the U.S.A.; the fuze in Birmingham; the cartridge at Waltham Abbey. Shiploads of each individual component might go direct to your overseas base ports. The three components would meet for the first time in the base ammunition depot—there be “married”—and go forward as complete rounds to railhead. It is complete rounds that are needed at railhead. Or again, take supplies. Man cannot live on cheese alone; he wants a complete ration—meat from the Argentine, cheese from Denmark, jam from Australia, tea from India. The component parts of the ration land at the docks in separate loads, they meet in the supply depots. The soldier gets a complete ration, sent forward to him in the supply pack train.

Dock Development.

Before leaving the subject of docks, it would be well to consider for a moment the problem with which the soldier may be faced at the beginning of a campaign by way of dock development. It will be readily realized that, in order to meet war-time military needs, the

average commercial dock will require considerable expansion and development, especially of its railway facilities, before it can serve adequately as the base port for an expeditionary force of any size. The development, during the Great War, of the ports of Kantara and Basra for the services of the force in Palestine and Mesopotamia respectively, are admirable examples of the development that may be required. These, perhaps, are extreme cases amounting practically to the construction *de novo* of two first-class ports fully equipped to meet the needs of very considerable forces ; the adaptation and improvement of an existing port would not call for quite such elaborate constructional work.

Sketch Diagram No. 1 indicates a type of development that could be installed fairly rapidly to utilize or extend the facilities of a port at the mouth of a river ; beyond the transit shed there would be more railway lines which have not been shown in the diagram. From this it will be clear that the placing of the necessary railway trucks in position for loading alongside the ships, hauling them clear when loaded, and replacing them by others, must involve a tremendous amount of shunting and marshalling of trains. Also, while shunting is in progress, the movement of dock labour across the permanent way must be reduced to a minimum or casualties will result.

To get over these difficulties the railway layout is so arranged with reference to quays, transit sheds and plant, that the shunting work can keep pace with the dock transit loading if certain free periods are arranged during which dock labour ceases. A short period at midday and one long period at night meets the case best, so dock labour is organized in shifts accordingly. It will be possible very rarely to work three shifts in docks in the twenty-four hours. Two eight-hour shifts with a short period between them is the best that can be expected. The actual organization is a matter which should be left to the technical expert, as experi-

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DIAGRAM. 1.

PROVISED ORG
THE MOUTH

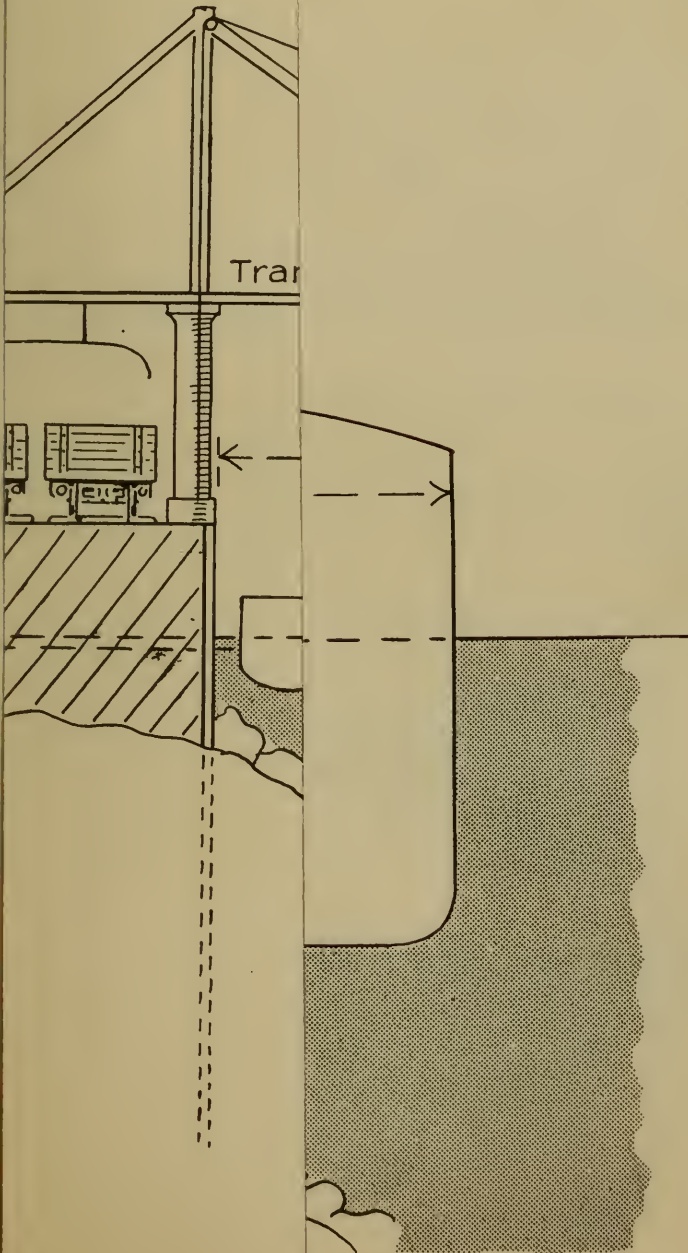
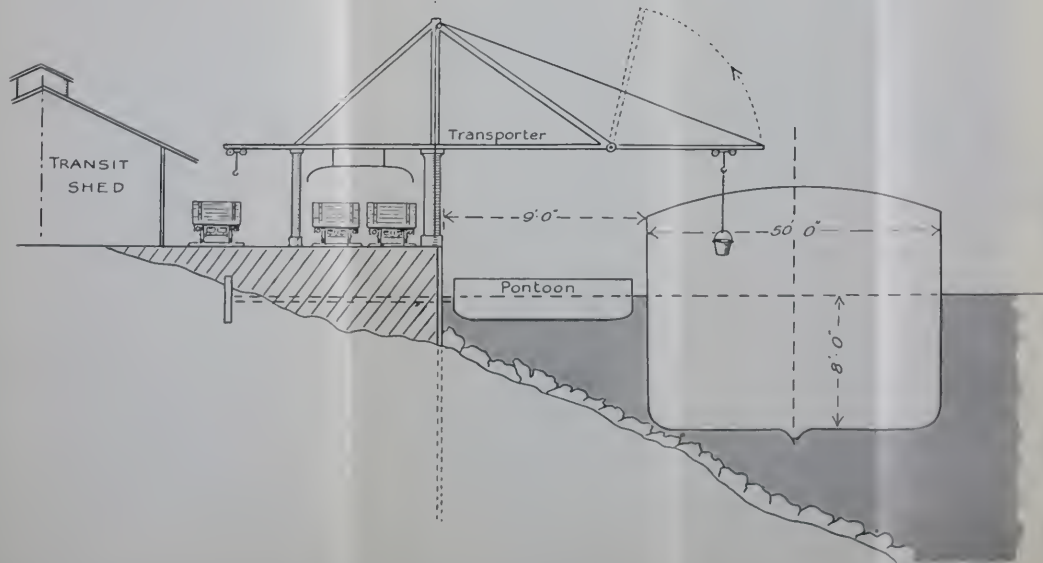


DIAGRAM OF IMPROVISED ORGANIZATION FOR DOCK WORKING
AT THE MOUTH OF A RIVER.



ence alone can decide the most suitable conditions to meet each particular case.

As regards the output, or dock capacity, that may be expected from a port under war conditions, it has been found from experience that, taking the averages of all army traffic and assuming single-shift working, from 1 ton to 1·2 tons per lineal foot of quay per day represents good working. An equipment of one wharf crane for every 100 feet of quay (in addition to floating cranes for special purposes) constitutes a satisfactory equipment, and an output of 110 tons per crane per day, single shift, represents good working average for all classes of cargo. For general cargo easily handled the output of a crane rises to 175 tons per day, and with such cargo as grain or flour in sacks 25 tons per hour, or say 250 tons per day per crane, is attainable. For every *hour in port* a ship should discharge from twenty to thirty tons of stores. It is generally most economical to work double shifts of from eight to ten hours a day each, if dock plant facilities are good enough; the remainder of the twenty-four hours being required by railway staffs for adjustments of railway rolling stock, etc.

Stores will normally be handled twice in the dock area—*i.e.* :

From quay to transit shed ;

From transit shed to railway wagon.

But when possible load direct from ships to railway wagon. Stores will again be handled twice in the depot—*i.e.* :

From railway wagon to stack ;

From stack to railway wagon.

A third handling may be unavoidable in the process of stacking. An average man can handle six tons of stores once per diem.

Section 4. The Organization of an Overseas Base.

It has been explained above how, in normal circumstances, our military stores, on first arriving in the

docks overseas, are forwarded thence by the transportation service into the base depots. In the base depots they are taken over by the services concerned and are subsequently distributed along the lines of communication to the troops in the field. Before dealing with the method of the further movement of the stores forward from the base, it would be as well to consider the system in accordance with which the organization and construction of a base depot is set on foot.

When an expeditionary force goes to make war overseas one of the first things it will want is a port to land at. Possibly it may be compelled, in the first instance, to land on an open beach. The maintenance requirements of a modern army are, however, so vast that a landing on an open beach can only be looked upon as a preliminary to the seizure, or possibly the construction (as in the case of Basra and Kantara during the Great War) of a properly equipped port at which to land its essential military requirements.

If we are lucky enough to find a first-class dock, equipped with up-to-date appliances, our first problem is an easy one, but this will not always be the case; we shall have to make the best of what is available and discover a means of getting over the difficulties presented by each particular case.* Probably no port is ideal for military purposes, and having selected the most suitable we shall have to develop and expand it to meet the army's needs.

What factors should guide us in selecting a port at which to land our army, or, if we have to construct a port for ourselves, what are its requirements? The primary requirements of a port, for whatever purpose it is intended, are firstly the means of ingress and egress, if possible at all states of the tide. This means an approach channel, breakwaters, buoys, lighthouses and pilotage arrangements. Next we require places at which ships can lie to load and unload, and also to undergo repairs. These places are quays, wharves,

sheds, appliances for rapid loading and unloading, and dry docks.

Thirdly, we must have the transportation facilities by rail, road, river or canal, or any combination of them, by means of which the goods can be conveyed from the quays to the distributing centres inland and vice versa.

In war, from one cause or another—enemy action, necessitating the convoying of ships, bad weather, or mechanical breakdown—delays to shipping occur with consequent irregular arrivals at the base ports. This overstrains the dock facilities at times and congestion arises in the port. This congestion may easily assume serious proportions, unless ample clearance facilities—generally far in excess of normal requirements—are provided to cope with it. As an example of this, the case of Vladivostok during the Great War may be quoted. Two million tons of munitions were landed at Vladivostok, but they never reached the Russian armies for whom they were intended, because the railways were inadequate to clear the port, and a hopeless state of congestion arose in the docks. It follows from the foregoing that we must have within reasonable reach of the port, but clear of the dock area, depots into which we can discharge the excess of goods, without reference to their ultimate destination.

Furthermore, when we are making war overseas, we must have reserves of all the army's needs stored in the theatre of operations. The amount of these reserves depends upon the distance from our ultimate base in the United Kingdom, on the liability to interruption of our communications and on a variety of other considerations that we are not concerned with at the moment. This again gives rise to the necessity for a base depot, the requirements of which, and the method of its organization, will now be examined.

The problem in this connection, which faces the advance party of our expeditionary force, consists primarily in establishing the best possible administrative

machine behind the fighting forces before they come to grips with the enemy. The whole of the preliminary arrangements for the organization of the base must be conceived and must be reduced to a clear plan, and the plan must not only consider the expeditionary force which first leaves the home country, but it must envisage what that expeditionary force is going to increase to, and what the liabilities are going to be at the base in, say, six or eight months or a year.

When one starts on active service, any mistake which is made in the initial stages is very difficult to rectify afterwards; consequently the work of the Advance Party is of all the more importance. At the same time, this preliminary work will in practice have to be carried out with the greatest possible speed. The Advance Party will be over at the new base, and everyone at home will be anxiously awaiting their first reports to enable them to complete their own preliminary arrangements for the provision of the various requirements for which they are severally responsible. The conditions may vary from the development of a Southampton, or an Avonmouth, to the complete installation of a port at a place like Basra.

It must also be kept in mind continually, in all problems of base organization, that operational questions must take precedence over questions of pure administration. We have now reached the stage that no base—so long as there are aircraft on the enemy's side—or no portion of the lines of communication, can be considered safe from air attack. If the port of disembarkation is within striking distance of the enemy's air forces, it may be taken for granted that, directly it is known to him that forces are being landed there he will, if possible, attack it heavily from the air, and our defensive arrangements must be organized accordingly.

The eventual expansion of an army operating overseas will normally require the development of at least one port in the theatre of war as a base for the maximum force which can be maintained from that base. The

size of this force will depend upon the capacity, existing or capable of development, of the lines of supply radiating from the port.

The preparation of even the rudimentary elements of a layout of this nature will involve extensive constructional operations by the Works and Transportation Services. This will take considerable time, a matter of months ; the landing of the expeditionary force cannot, however, be delayed until the base is built. In the meantime, such forces as are landed have got to be maintained in all their fighting and administrative necessities, but the landing of the force and its maintenance when landed should not be allowed to interfere with the constructional development of the base area.

In principle, therefore, the best plan is to land the original force at one port and maintain it through the same port, while developing another port as the permanent base. When the permanent base is ready, transfer the maintenance of the force to its permanent home. This, however, will often not be a possible plan, and we may be compelled to use one port only and so organize our temporary maintenance arrangements as to interfere as little as possible with the development of our permanent organization.

The problem at a port like Southampton would be an easy one ; the problem at Basra was very much the reverse. Throughout the three volumes of the official history of the Mesopotamian Campaign there are references to the difficulties arising from the deficiencies of Basra as a base port. The development which was eventually carried out there was colossal, and forms a most interesting study. In Vol. III, pp. 255-257, there is a short description of how Basra grew from nothing to a great port extending over many square miles.

Our problem of base organization can now be summarized as follows :—

- (i) To make a plan for the development of the port or ports selected.

- (ii) To make a plan for the temporary maintenance of the force.
- (iii) To make a plan for the permanent maintenance of our ultimate force.

Having stated the nature of the problem, we will now consider how it is tackled.

The advance party, whose duty it is to prepare the plan, would consist of the officer appointed to command, pending the arrival of the C.-in-C., and such staff officers from G.H.Q. 1st Echelon as the C.-in-C. may direct. The party would also include the Directors of all the services or their representatives, the Base Commandant and the G.O.C. L. of C. Area, representatives of the Air Defence Commander and the Air Officer Commanding, of the Admiralty and the Board of Trade, with assistants and office establishments as necessary. This party, together with the necessary L. of C. administrative units, air defence troops, and such covering force as might be required by the circumstances, would proceed overseas in advance of the main forces.

It is obvious that the party outlined above would be of considerable size, and it is most desirable in consequence that it should itself be preceded to the overseas base by a small reconnaissance party, consisting of certain staff officers and representatives of services, to make the preliminary arrangements required before any troops arrive at all. It is the work of this small reconnaissance party, which we will call the staff of the advance party, which will now be considered. Their procedure would be as follows :—

- (i) Immediately on landing—or before, if maps and intelligence are considered sufficiently reliable—the staff of the advanced party hold a conference, calling in the Base commandant and senior Transportation Officer. A preliminary plan (1st Key Plan) of organization is prepared by the A.Q.M.G. as the joint work of this conference, under

which each service is allocated tentatively the sites it requires.

- (ii) Heads of services are now called into the conference, and the A.Q.M.G. explains the general idea of his proposals—*i.e.*, he lays down a tentative administrative policy and the general arrangements proposed for each particular service. This constitutes the Maintenance Project (*i.e.*, the first issue of administrative instructions of which the 1st Key Plan is the map).
- (iii) On termination of this conference, or on landing at the overseas port, the heads of the services arrange to reconnoitre the proposed sites, and, with the assistance of a transportation officer, prepare a scheme for the utilization of these sites.
- (iv) At a prearranged time a second general conference is held, the A.Q.M.G. presiding. At this conference all services in turn represent verbally the views they have arrived at as a result of ground reconnaissance, and the staff, considering their views, give immediate decisions on conflicting claims or any other difficulty that may have arisen.
- (v) On termination of this conference, the staff should be in a position to draw up the 2nd Key Plan of organization and to amend if necessary the Maintenance Project ; while the services can complete in detail all work in connection with the layout of their various installations. If difficulties have arisen, further discussion on the ground may be necessary with the staff present to give decisions. Final detailed drawings of depot layouts can, of course, only be made after survey work has been completed.

Throughout the whole of these preliminary arrangements, the officer appointed to command, pending the arrival of the C.-in-C., must be kept in touch with the proceedings, and his agreement to the final plan must be obtained having due regard to the operational aspect of the question and the problem of A.A. defence.

Some Difficulties and how to tackle them.

The organization of the base area is primarily one of movement. The base port should be regarded purely as a transit area. All material landing with and immediately following an expeditionary force being sent forward to a temporary depot either in the troop concentration area or in the close neighbourhood of the port. Simultaneously the organization of the permanent base area should be set on foot, and it is necessary to ensure that the temporary maintenance arrangements are such as not to interfere with the development of the permanent organization.

First, lay out the dock area. This will become a reserve transportation area, and in it there must be no storage other than depots mostly of a very temporary nature connected with the development and maintenance of the port itself.

Next, decide on the locality of depots, their size, and transportation conditions.

The layout of the depots themselves is a technical matter for the services concerned in consultation with the Transportation Directorate. The staff must, however, be prepared to advise in connection with the co-ordination of movement generally, to decide in cases of conflicting interests, and to watch the situation with regard to air defence.

The guiding principle in selecting depot sites is to allow for the maximum expansion possible, consistent with the capacity of the actual port when fully developed and eventual possible expansion of the field army. It is far better to err on the large side than otherwise, and at the beginning of a campaign a wise precaution

would be to double whatever area was considered necessary in the first instance.

The difficulty of siting the various base depots is to reconcile the conflicting claims of administrative convenience and tactical necessity as represented by the problem of defence against air attack. In consequence of this, it will generally be necessary to locate base depots for personnel and animals a considerable distance from the actual docks, even if this involves marches up to five or six miles. As regards the stores depots of the various services, there are certain rigid factors which will nearly always operate against any wide dispersion of them, however urgent the tactical necessity for such dispersion may be.

The chief reason for this is that *flat ground* is an absolute necessity where any large layout of railway sidings is needed. In modern war the quantity and bulk of stores is so great that large store depots must be railway fed. This involves a network of sidings adjoining the depots, where strings of trucks can stand while waiting to be loaded or after loading. Such sidings cannot be on an incline, and the time and labour involved in levelling any large area of undulating ground would usually be prohibitive. Hence it follows that the railways must be given first claim on any flat ground available and they must make the best of it wherever situated. If the total area of flat ground is small, as will often be the case, the base depots for stores which must necessarily cluster round this flat area, may often be dangerously close together.

The remedy appears to be :—

- (i) In the provision of adequate A.A. defence.
- (ii) In not attempting to supply too large a force from one set of depots—*i.e.*, several baskets for the eggs instead of one.
- (iii) In so planning the individual depots in one area that a bad shot at one would not hit its next-door neighbour.

Yet another important consideration to bear in mind when siting our base depots, is to locate them so as to reduce the dead mileage of railway wagons to a minimum, and to avoid all unnecessary counter-marching of stores as between port and depot, and depot and regulating station or railhead.

The following diagrams show the normal type of layout to be adopted in constructing base depots. Plate A shows a supply depot, Plate B an ordnance depot, and Plate C an ammunition depot. In each of these plates Fig. 1 shows the regular layout which would be ideal from the operating standpoint, but one which would only be obtainable in comparatively open and level country. The other figures show how the same type of layout can be adapted to suit local peculiarities of ground.

It might be argued that the somewhat rigid and rectangular designs indicated in the diagrams referred to above will afford ideal targets for attack from the air; this is to some extent true, but any attempt to scatter or unduly spread out the depot with a view to minimizing the effect of air attack requires so much railway construction and necessitates so excessive an amount of engine mileage within the depot itself, as to be unsuitable in practice except in the case of quite small depots. It is considered that the standard types shown in the diagrams should normally be adopted, the risk of air attack being met by adequate A.A. defence, by traversing and by fire precautions within the depots themselves.

The actual acreage required by the various services to accommodate their respective base depots will be effected by a variety of considerations: the scale of reserves to be maintained, the nature of the country, the topographical conditions, the size of the force, to name only a few. Bearing in mind the possibility of future expansion, which past experience has shown to have been seldom sufficiently realized at the beginning of a campaign, it would be as well to set aside areas

To face page 40

DIAGRAM 2

PLATE A.

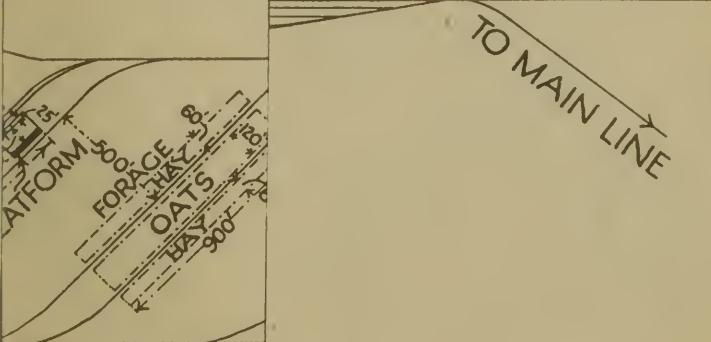
SUPPLIES

CASES)

TONS

1/4 MILE

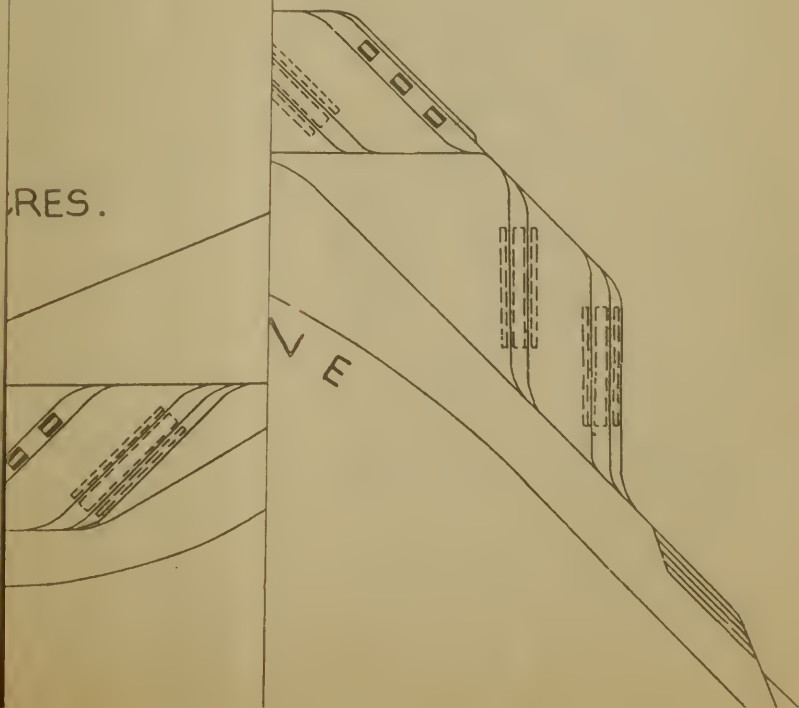
CAPTURE
POINTS



MAIN LINE

RES.

LINE



SUPPLY DEPOT

TO HOLD SUPPLIES FOR 18 DAYS FOR 150,000 MEN & 45,000 ANIMALS

PETROL (IN TINS & CASES)
AREA 5 ACRES
TO HOLD 3,000 TONS

FIG. 1.
AREA 133 ACRES.

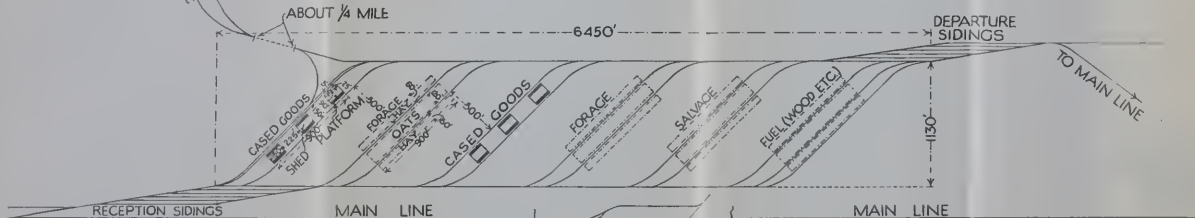


FIG. 2
AREA 204 ACRES.

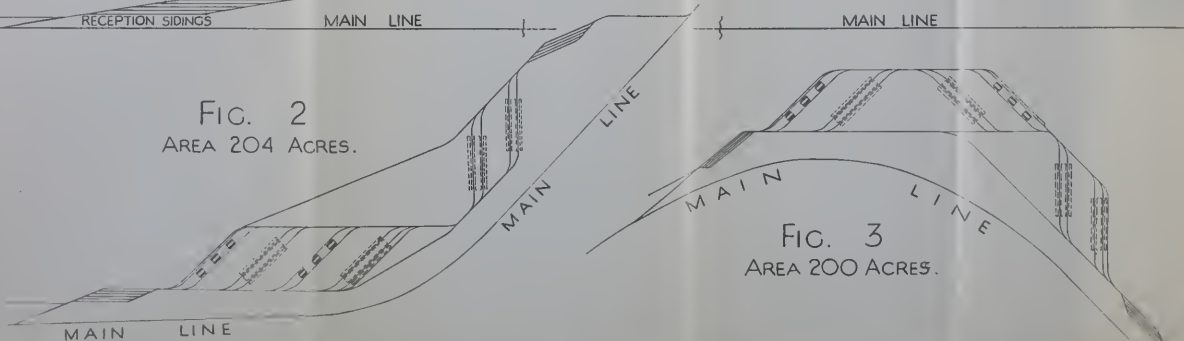
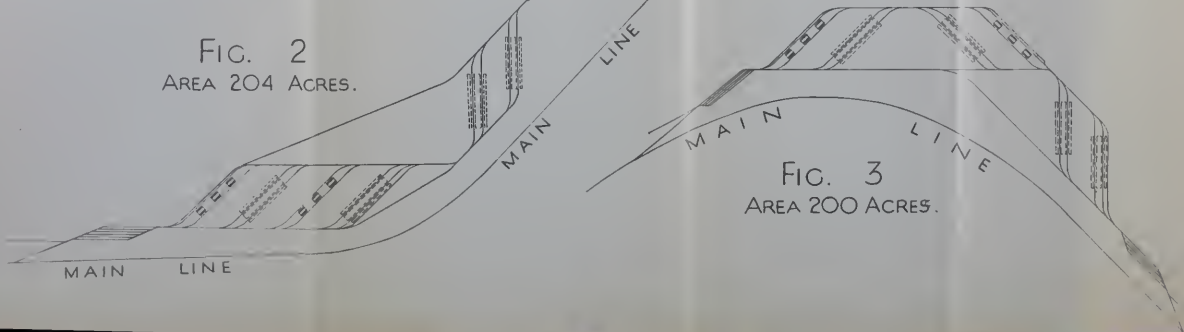


FIG. 3
AREA 200 ACRES.



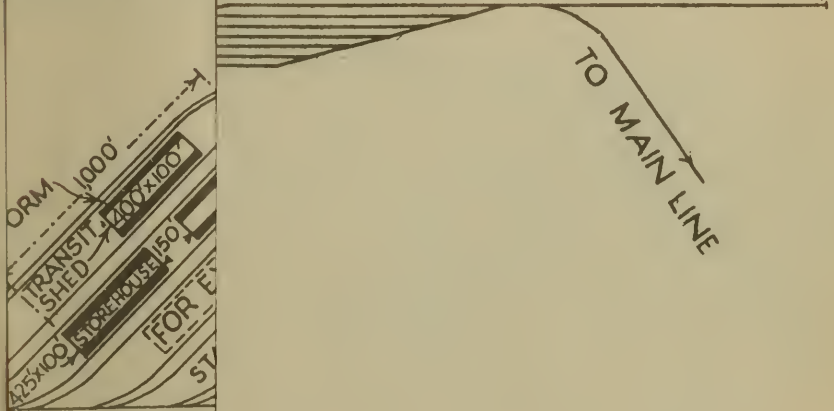
To face page 40.

DIAGRAM 3

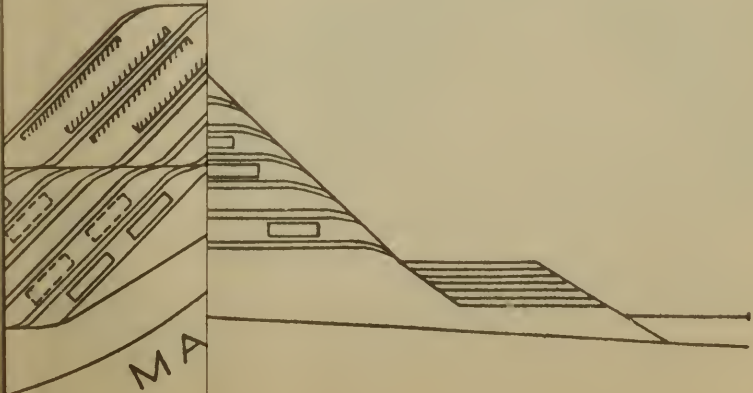
PLATE B.

ENTRY FOR EXPANSION

TABLE FOR
ION STOP DEPARTURE
SIDINGS



AP



ORDNANCE DEPÔT

FOR A FORCE OF 5 INFANTRY DIVISIONS & 1 CAVALRY DIVISION, INCLUDING SPACE FOR EXPANSION
UP TO 20 DIVISIONS.

FIG. 1.

AREA 111 ACRES.

N.B.

THIS TYPE OF DEPÔT IS ALSO SUITABLE FOR
WORKS AND TRANSPORTATION STORES

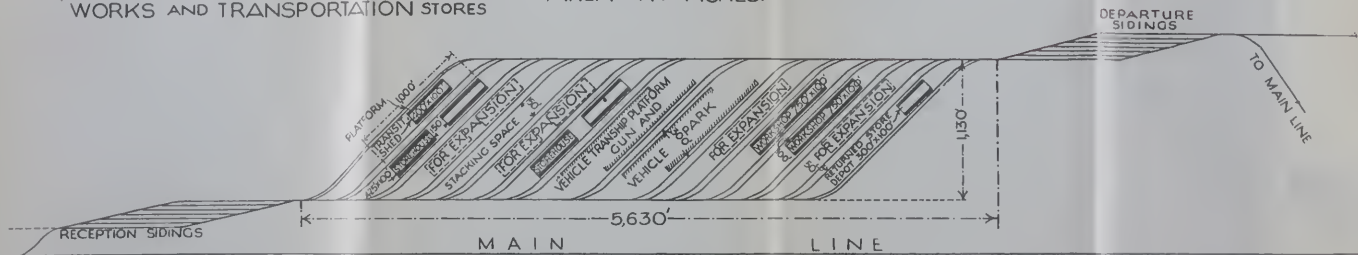


FIG. 2.
AREA 115 ACRES

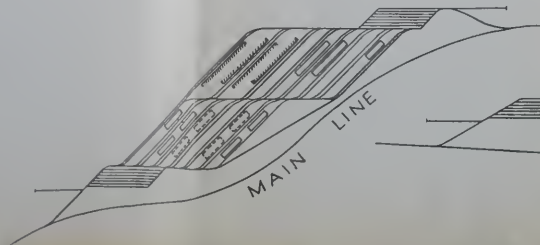
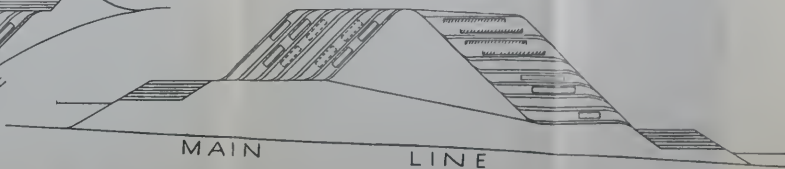


FIG. 3.
AREA 137 ACRES



To face page 40
DIAGRAM 4
PLATE C

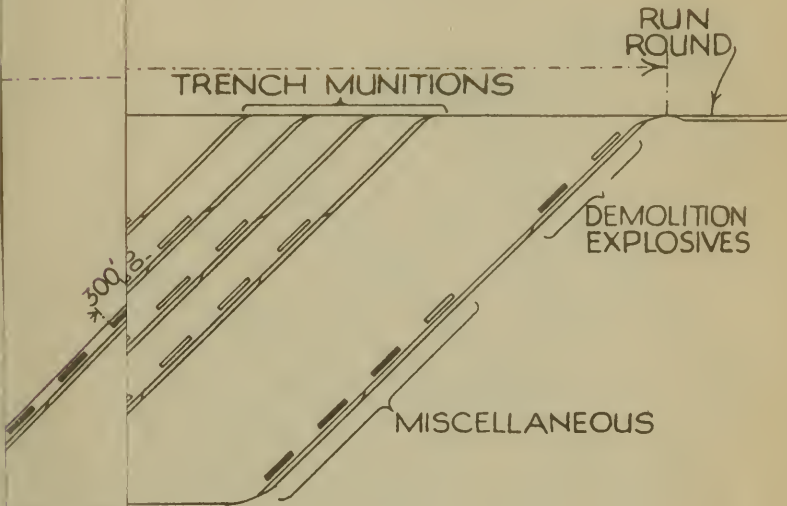
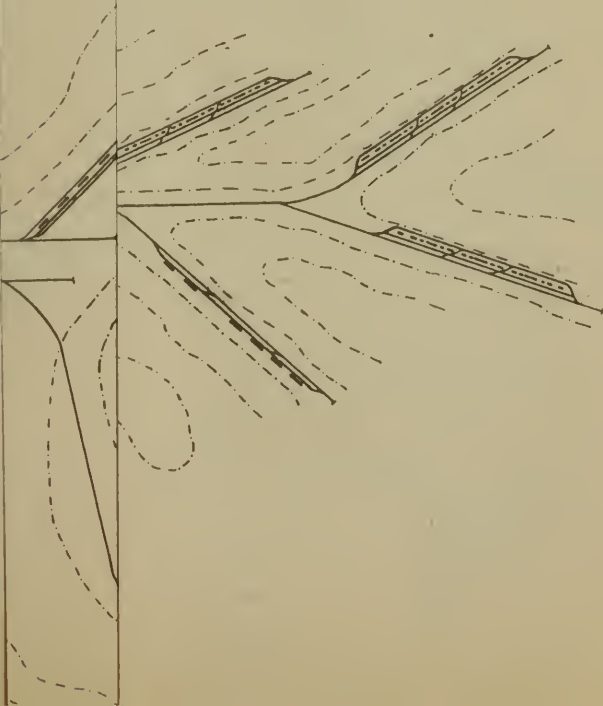


FIG. 3



To face page 40

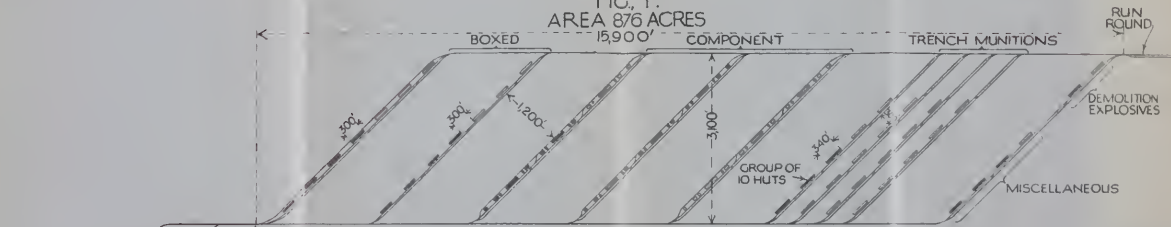
DIAGRAM 4

PLATE C

AMMUNITION DEPÔT [STANDARD SIZE]

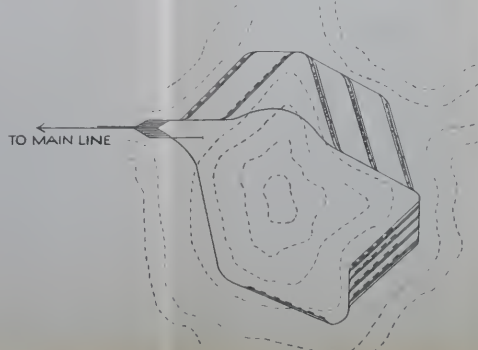
INITIAL SHED & STACKING SPACE REQUIREMENTS
FOR 5 INFANTRY DIVISIONS & 1 CAVALRY DIVISION
SHEWN IN BLACK.

FIG. 1.
AREA 876 ACRES



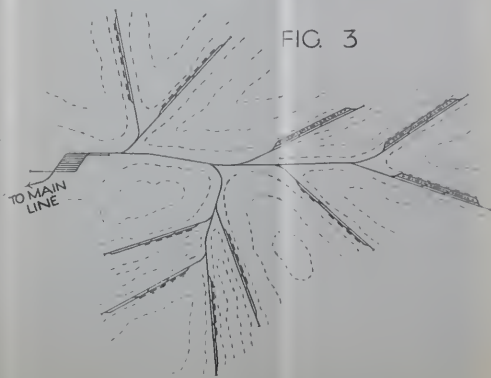
TO MAIN LINE
RECEPTION & DEPARTURE
SIDINGS.

FIG. 2



TO MAIN LINE

FIG. 3



TO MAIN LINE

on the following scale when first planning the general layout of a base depot area for a large force :—

For supplies	...	...	From 250 to 500 acres.
For ammunition	...	...	From 500 to 1,000 acres.
For transportation stores	...	...	From 100 to 200 acres.
For engineer stores	...	...	From 100 to 200 acres.
For ordnance stores	...	...	From 100 to 200 acres.

(Including workshop and returned stores depot.)

Petrol and oil require a special and separate sub-depot, on the scale of 150,000 gallons per division per month for all services, including R.A.F. This figure may have to be increased as mechanization of the army proceeds. The proportion of oil to petrol is as 1 to 10. The petrol reserve should be forty-five days supply, when other stores are at thirty days supply.

The above figures can only be taken as a rough guide, as the circumstances will vary in each case, just as the organization of an expeditionary force will vary to meet the requirements of particular theatres of operations.

The bulk maintenance requirements of an expeditionary force of all arms may be calculated by allowing one-third of a ton a man a month for all maintenance stores, except railway rolling stock and heavy bridging material. This is based on an overall figure of 40,000 men per division, which allows for all ancillary services, and non-divisional, or L. of C. troops ; while the stacking space required for most classes of stores can be taken as approximately one thousand tons to an acre.

Apart from store depots of various kinds, there are medical and hospital areas, personnel camps, remount and veterinary depots, and aerodromes to be provided for. The points, to be considered in their location, may be summarized as follows :—

Medical and hospital areas should be located well clear of the store depots and of the reinforcement camps. They require access to the broad-gauge railway, but should not be within five hundred yards of the main line. Their location should be convenient for the evacuation of casualties to the hospital ships.

Personnel camps should be within an easy march of the landing place and of entrainment stations. They are required in two parts—one for the temporary reception of units passing through and the other for reinforcements.

Remount and veterinary establishments should be located near each other in order to facilitate the transfer of animals. Not more than 2,500 animals should be grouped in the same locality. Veterinary provision should be made for from seven to ten per cent. of the animal strength of the force.

Aerodromes, apart from technical flying requirements, need both railway and road access for their stores and ground organization.

The Maintenance Project.

Turning now from questions of the siting and layout of base depot, the next task of the advance party to consider is the compilation of the Maintenance Project.

The first project is prepared before any reconnaissance has been made. In conjunction with the 1st Key Plan it forms the basis upon which the reconnaissance is carried out, and it is almost certain that considerable amendment will be necessary as the result of actual ground reconnaissance; the amendments will subsequently be embodied in the 2nd Key Plan and 2nd Maintenance Project.

This first project must not be too long, or too detailed; there is no time for detailed instructions at this stage. It is however, all that the heads of services will have upon which to base their estimates for their requirements in the early stages of the overseas concentration. It must, therefore, contain sufficient instructions to co-ordinate the work of the administrative services on first landing. It is the basis upon which the embarkation and landing programme of the administrative troops, and the first consignments of matériel, will have to be framed.

To meet these requirements the Maintenance Project should :—

- (i) Aim at defining the proposed limits of geographical responsibility of the various sub-area commanders by fixing the location of reserved transportation areas, hospital areas, base personnel camps, depot areas, etc.
- (ii) Define the general policy for the movement of everything which is about to arrive in the port, whether personnel or matériel.
- (iii) Provide a means of dealing with the immediate administrative problem on landing in respect of such items as medical, provost, traffic and supply services.

The 2nd Key Plan and Maintenance Project are prepared after reconnaissance ; they cancel the first ones and give a more complete and more detailed picture of the organization and proposed working of the base area, correcting anything in the first project which reconnaissance has shown to be unworkable or inadvisable.

The Priority List of Sailings.

Based on the 1st Maintenance Project, a priority list of sailings has to be prepared and arrangements set on foot for embarking the necessary units and stores. A priority list of sailings is a form showing the number and types of vessels required to reach the port of disembarkation each day and the particular nature of unit, or class of stores, with which each vessel is to be loaded. Owing to the necessity for speed, it will seldom, if ever, be possible to wait until reconnaissance reports are received from the overseas base. It is necessary, therefore, to appreciate the situation as it will be at the beginning of the landing operations and to arrange your list of sailings accordingly.

The original list of sailings must cover the period from the beginning of preparations for the dispatch of the

force until the advanced party has arrived overseas, carried out its reconnaissance and cabled home its decisions. From that time onwards a new list of sailings can take effect, based on definite knowledge.

If the theatre of war is a distant one, and the expeditionary force is small, it is probable, having due regard to the time factor, that the advanced party will hardly be in a position to influence the order of sailings to any marked degree, but for cross-channel work the order of landing and sailing of ships can be controlled to a much greater extent from the overseas base.

Consideration of the problem will show that exclusive of the advance party itself, but before the dispatch of the combatant troops of the expeditionary force, arrangements should be made to send forward certain ancillary units. These may be sent in part concurrently with the advance party, and in part as soon as possible after it. Also there are certain ancillary units (such as hospitals, workshops and supply units, etc.) which should receive a high priority in the order of dispatch of the expeditionary force but not necessarily be sent before any of the combatant troops.

It is obvious that you can do little or nothing without transport. Engineer stores for port construction and transportation material are early requisites. Material without tools and tools without material are equally useless.

Finally—or perhaps it should be placed first of all—there is the problem of defence against attack by the enemy's air force: to what extent will it be advisable for A.A. defence units and R.A.F. units to have priority over all else in our list of sailings?

It will also be necessary to consider, in conjunction with the Board of Trade representative, the number and types of vessels available, the kind of cargo for which each is suited, and their speed.

Next must be taken into account the facilities, known or assumed, of the port of disembarkation. How many vessels of each type can the port deal with daily?

Then there is the "rate of turn round" of each ship—that is the time taken to enter the port, unload the cargo and clear the dock again. In the case of a tidal river this "turn round" is usually expressed in terms of tides.

These, then, are the considerations which must influence the compilation of a priority list of sailings:—

- (i) The order in which units and stores are required to arrive.
- (ii) The number and types of vessels available.
- (iii) Capabilities of port of disembarkation.
- (iv) Rate of "turn round" of each type of vessel.

With this information, the rest is a matter of form, and the following form is suggested as suitable:—

Serial No.	Type of Vessel.	Date		Nature of Cargo.
		Leave.	Arrive.	
	(a)	(b)	(c)	(d)
—	—	—	—	—
—	—	—	—	—
3.	A.C. Barge ...	—	21st	Canned petrol and oil.
4.	" C " ...	—	21st	1st A.A. Bty. R.A.
5.	" A " ...	—	22nd	1st Rly. Survey Unit, 1st Dock Coy.
—	—	—	—	—
—	—	—	—	—

(Serial Nos. 3, 4 and 5 are given merely as examples.)

Column (b) would normally be completed by the Admiralty representative in conjunction with the Board of Trade and in accordance with the known speed of the vessel. At the end of each day's arrivals on the form, it is helpful to summarize the total number of vessels due to arrive that day; this total must, of course, not exceed the capacity of the port. The number of ships which can be received on the next day will depend on the rate of turn round of those already in port, and the number of berths which will be available. If a vessel requires four tides to clear, the berth which it occupies will not again be available until the third

day of disembarkation. The form is made complete by inserting at the top of it the rate of turn round, for each type of vessel, which has formed the basis of your calculations.

As regards the order in which units and stores are required to arrive, this might conceivably be somewhat as follows :—

- (a) The advanced party as outlined previously in this chapter.
- (b) Air defence troops (proportion of).
- (c) L. of C. administrative units.
- (d) Advanced parties of units and formations.
- (e) Main body.

Supplies and stores are, of course, required concurrently with above.

The actual order of landing of the main body will depend on circumstances, but the following should be given early priority :—

- Remainder of air defence troops.
- One general hospital.
- One composite railway company.
- One reserve M.T. company.
- Railway construction and operating troops.

Divisional supply and baggage companies should precede their divisions.

Some further notes that may be of assistance in the work of base organization are contained in Appendix 1, which follows.

APPENDIX I.

SOME POINTS OF DETAIL IN ORGANIZATION OF BASE
DEPOTS.

1. Base Ammunition Depots.

(a) *Amounts required as a First Supply.*

	Tons.	Sq. ft. floor space.
Boxed amn. for Q.F. guns and S.A.A.	5,500	37,000
Unboxed B.L. Amn.	1,500	16,000
Bombs, grenades and demonstration explosives	500	4,400
Miscellaneous and Smoke Amn. ...	750	9,000
	<hr/>	<hr/>
Totals	8,250	66,400
	<hr/> <hr/>	<hr/> <hr/>

When possible, cover should be provided for all natures. A standard shed for a base ammunition depot is 300 feet by 30 feet. Sheds are arranged in groups 400 yards apart and with 100 yards between sheds. At the beginning of a campaign extemporized arrangements will probably be necessary, and railway services may not be available. If so, the first necessity is road access to all dumps, so that lorries can reach the ammunition.

For each ton of ammunition to be stacked allow :—

- (i) One square yard of good surface.
- (ii) Six feet run of timber dunnage.
- (iii) One and a half square yards of tarpaulin.

If a permanent depot is to be built, do not make temporary dumps on sites selected for sheds, as they will interfere with the building of the sheds.

(b) *Labour of Ammunition Depots.*—R.A.O.C. personnel is employed on supervision work ; in addition, labour is required for loading and unloading, stacking, sorting, etc. For continuous working over long periods a working basis of approximately 6 tons per man per day can be taken. For a base ammunition depot receiving and issuing two trains a day (760 tons in and 760 tons out) about 250 labourers will be required.

(c) *Ammunition for R.A.F.* is supplied through army ordnance service, a small R.A.F. detachment being attached to the base ammunition depot for technical supervision.

(d) *Ammunition Depots.*—A standard base ammunition depot would contain about 38,000 tons of ammunition of all natures. This would probably suffice for a force of from seven to ten divisions with normal complement of non-divisional troops and R.A.F. A depot of this nature will take from three to six months to build, according to amount of labour and material available. About one square mile is required for such a depot with its personnel camp. The site chosen should be at least a mile from any village, town or military installation liable to damage in case of explosion. In other respects the location of depots will depend on the requirements of the A.A. defence plan and on consideration of transportation facilities.

(e) *Ammunition dumps* in forward areas are constructed on the same general principles as base depots, but on a very much smaller scale, the question of concealment from air observation and minimizing of the effects of air attack assuming increasing importance. Road as well as rail access to such dumps is generally necessary. By arranging the ammunition in stacks of 100 and 200 tons, and allowing 100 yards clear between stacks, 1,000 yards of road will accommodate from 1,000 to 2,000 tons of ammunition.

(f) *Ammunition Trains.*—In the early stages of a campaign, and when operations are very mobile, *encas mobiles* (always undesirable from a transportation point of view) may be necessary for the maintenance of ammunition supply. These trains are depots on wheels, capable of movement at the shortest notice. The size of the ammunition train is limited by the capacity of railheads, and runs normally to about forty trucks (including any for personnel). This means about 350 tons of ammunition. When operations are more stable, ammunition trains are unloaded on arrival at

railheads and the trucks are released ; the ammunition being placed in dumps in the vicinity of, but at least half a mile from, the railhead, or being carried forward by M.T. to formations. It takes about two hours to clear an ammunition train (350 tons), the labour being provided by the local administrative commandant. Six trains a day represent the maximum for a well-equipped railhead, but three trains a day represent a good working under normal conditions. In principle an ammunition railhead should be used for no other purpose.

2. Ordnance Stores Base Depot.

Amounts required as a first supply of maintenance stores would be three weeks' estimated expenditure in addition to complete personal and unit equipment for one-fifth of the force. Say, 250 tons (D.W.) per division. The above would be for issue to fighting formations. To this must be added stores for field use, such as barbed wire, field tools, rope, etc. Say, one cargo of bulk stores of this nature in the first instance.

Large amounts of tentage will be required early both for personnel camps and for base depot purposes.

Ordnance stores require one acre per thousand tons for stacking, and covered accommodation is most essential for many classes of stores—clothing and blankets, for example.

3. Engineer Stores. (Works Services.)

In the first instance required in two sections :—

- (i) Temporary depot handy to port for material required for port development (timber, tools, spikes, dogs, etc.).
- (ii) Permanent Base Depot for all classes of material both for Base Area development and for field use. This latter should be near Transportation Base Depot, as latter will demand heavily for bulk stores.

Requirements for Port Development.—Thirteen tons per yard of quay constructed, including timber and fastenings.

Requirements for Base Development.—Allow 2,000 tons for all classes of material in first instance.

Requirements for Field Use.—Timber, 1,000 tons; general stores, 1,000 tons per division (disregard cavalry).

Space required for stacking, 1,000 tons to an acre. Allow room for expansion.

4. Transportation Stores.

Bulk stores in the first instance, other than specialized stores, such as rails, wheels, axles, spare parts, etc., are obtained from R.E. stores. Stores will be required for :—

- (i) Port development.
- (ii) Base Area development.
- (iii) Forward L. of C. construction.

Allow 70 to 100 acres for railway purposes, shops, etc. For railway development allow 500 tons of railway material for every mile of broad-gauge track to be constructed, including spurs and sidings.

Allow 1,000 tons to an acre for storage space.

When circumstances admit, Ordnance, Transportation and Works depots should adjoin one another; there is much interchange of stores between them. They all require workshops.

Section 5. Movement of Stores by Rail.

As pointed out above, our stores on first landing in the docks at our overseas base port will normally go direct from the docks into the base depots, which are constructed clear of the dock area. The next point to consider is the manner of movement of the stores forward from the base along the lines of communication to the troops. This forward movement will be carried out by road, rail or inland water transport, according to circumstances, but in most cases it will be done in

To face page 50.

DIAGRAM. 5.

THE SYSTEMS TO RAILHEADS.

Base
Marshalling
Yard and
Reg. Stn.

Marshalling Pack Trains
Yard and Bulk Trains

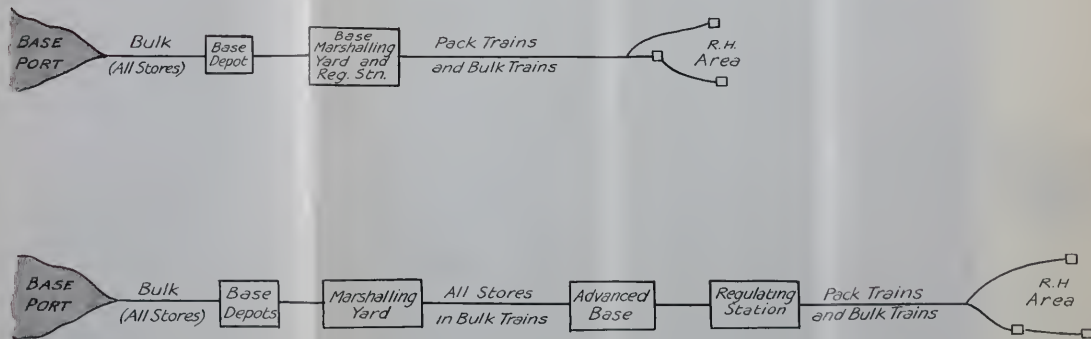
R.H.
Area

se to Railheads is short, the
Yard and the Regulating
the same place.
is long a Regulating
group of Depots to serve it
within from six to twelve
Railhead Area.

To face page 50.

DIAGRAM 5.

DIAGRAM TO EXPLAIN THE SYSTEM OF MOVEMENT OF STORES FROM BASE PORTS TO RAILHEADS.



Note :- If distance from Base to Railheads is short, the Base Marshalling Yard and the Regulating Station may be the same place. If the distance is long a Regulating Station with a group of Depots to serve it will be required within from six to twelve hours run of the Railhead Area.

the first instance by rail. There are two systems in general use for forwarding stores by rail—the Pack Train or the Bulk Train. Diagram No. 5 shows the systems graphically.

Pack Trains are formed by collecting loaded wagons from all kinds of depots and installations—supplies, ordnance, postal, base laundries, M.F.O., etc.—and thus forming a train daily whose contents are destined for a particular formation, not for a particular railhead. The latter may change while the train is in transit on the lines of communication. Stores normally sent by pack train may be conveniently called “Pack Stores,” and they are sent in accordance with specific demands made by units. The collection of the trucks which go to make up the pack train, and their formation into the complete train, are carried out at the Base Marshalling Yard or Regulating Station.

Supplies for one division for one day weigh approximately 148 tons, and require seventeen to nineteen 10-ton railway trucks to move. This includes hay, oats, meat, groceries, bread, mails, ordnance stores, petrol and oil, M.F.O. stores, coal and N.A.A.F.I. stores, which comprise the normal contents of the pack train section for one division.

Supplies for one cavalry brigade for one day weigh approximately 53 tons, and require nine 10-ton trucks to move.

Normally two divisional sections go to each pack train. Corps and Army troops have special packs or are combined with divisional packs according to strength. On continental railways the maximum pack train would consist of forty-eight wagons and two brake vans.

When conditions admit, or operations are sufficiently stable, pack trains, in so far as R.A.S.C. supplies are concerned, may be made up as “standard packs,” carrying the same quantities of stores each day; the balance of requirements to meet comparatively small fluctuations at railhead being sent up in a “variable pack.” The adoption of this system very greatly

facilitates the labour of loading up the trucks in the base supply depots.

Bulk Trains are full train loads, loaded homogeneously with one class of store, such as, for example, engineer stores, coal or road stone. They originate usually at one single base depot, and are destined for one particular railhead or locality. The contents of such trains are taken over by a formation at destination, inasmuch as if the formation changes location, it leaves the stores behind in the area it has quitted.

Bulk stores are generally "Area Stores" rather than "Formation Stores," though unit or formation stores may sometimes perform part of their journey in bulk, especially between depots and regulating stations.

The great difference between pack and bulk stores lies in the rail movement. With "pack" stores the formation and dispatch of the pack train is complicated by the fact that their component wagons—often containing perishable supplies—come from all over the place, and yet the train *must* be dispatched from regulating station punctually to time, otherwise late arrival and disorganization of road transport services forward of railhead will result.

On the other hand, stores travelling by "bulk" train are more simple to handle. The train can be made up complete in the depot, and, provided the formation taking over the contents at railhead is warned in time of the day and hour of arrival, it does not matter within fairly wide limits which of the available railway timings is utilized :—

It follows from these conditions that—

- (i) Everything possible should be done—for example, by convenient location of *unit store* base depots—to help the "pack" store transportation problem.
- (ii) "Bulk" stores base depots can be located much more freely, transportation conditions being able to give way to a much greater

extent to the requirements of holding services concerned.

A secondary deduction is—

- (iii) When conditions permit, as much movement as possible should be done by “bulk” store. This, of course, may necessitate the formation of dumps in railhead areas.

In practically every case of bulk trains, clearance must be effected into a railhead dump, because the bulk train must be released as quickly as possible, and because drawings of bulk stores are quite often on detail—*i.e.*, bulk is broken at railhead. Furthermore, if enemy air action is very effective, it may even be necessary to clear pack trains to railhead dumps in concealment, so as to reduce the visible activity actually in the station to a minimum. Railhead dumps must, of course, *not* be in the station, but well clear of the reserved transportation area of the actual railhead.

The following table shows the normal proportion of the different types of train loads required and average load of trains.

TABLES FOR RAILWAY CALCULATIONS.

I. Percentage of Train Loads (France 1914—18).

Food supplies for men and animals	...	40	per cent.
Ammunition	... ..	20	„
Reinforcements	... ..	13	„
Engineer stores	... ..	9	„
Road stone	... ..	9	„
Various	... ..	9	„

100

II. Truck Loads.

In England, in peace, the average load of a 10-ton truck of general merchandise is barely 3 tons.

With careful loading it should be possible to load truck of military stores to an average of 5 to 7 tons in a 10-ton truck.

For general calculations, the useful load of a train

is half the gross weight. This figure becomes a determining factor when rail capacity is limited by steep gradients.

III. Water required for Railways.

Allow 60 gallons per engine per mile, and add 2,000 gallons per engine per week for washing-out.

IV. Material for Railway Construction.

Allow 300 tons of technical material per mile.

V. Trucks required for Traffic Maintenance.

Allow one wagon per mile for each pair of trains per day. Thus, L. of C. 200 miles : say, 16 pairs of trains per day, will require 3,200 wagons in use.

A question may arise in connection with the movement of petrol. If and when petrol is to be a bulk supply, it may require railhead storage in the form of *encas mobiles* of rail tank wagons. No other form of storage is likely to be practicable at railhead. In that case, it will probably be best to treat petrol like ammunition and give it a separate railhead to itself. That is to say, to treat it as a "bulk" store. If, however, it is in cans—as probably it will always be necessarily for about 20 per cent. of consumption—it is best treated as a "pack" store, to be drawn from pack trains at supply railhead.

An important form of railway movement of stores is by *encas mobile* train. That is, a train kept loaded with supplies, or petrol, or ammunition, which can be kept standing in a siding. It constitutes a mobile railhead dump, but it also constitutes a transportation crime. It locks up valuable railway rolling stock, which is never sufficient for all requirements. It takes up siding accommodation ; it is conspicuous from the air, and may afford useful information to the enemy ; it is sometimes dangerous and may require the construction of special sidings, as in the case of ammunition or petrol ; yet as a mobile reserve it may be very valuable,

if not essential; but it should never be resorted to without very good cause for the reasons just indicated.

Reference has already been made to the importance of balancing the traffic generally throughout the whole of a movement system—that is, throughout the whole of our lines of communication. If one rules out railway accidents—*i.e.*, technical failures—the chief cause of any failure of the lines of communication in rear of railheads is late running, due either to too great length of line from base to railhead, or to over-burdening the capacity of the line. Both these matters, though in the first instance technical matters for the transportation service, are in point of fact staff matters, and if the transportation service, according to its duty, had brought either to the notice of the Staff, their continuance or occurrence is a sure indication of bad staff work. What are the remedies should these difficulties arise?

If the trouble is the length of the line, the Staff should have taken steps in good time for the establishment of a new advanced base farther forward. If due to overloading, the Staff should have seen to the reduction of military traffic, even though that would mean a reduction in military activity. Nothing is more fatal than to overload the line of communication, and in this matter very careful consideration must be given to the advice of the Transportation Service. This question assumes very great importance when, owing to actual physical difficulties, the capacity of a portion of the lines of communication is limited, as in the case of the North-West and Western Frontiers of India, in the event of a war in Afghanistan.

It must not be forgotten that the establishment of an advanced base not only brings into existence a new and important point to be defended, but also takes time to establish. During its establishment, too, it brings additional traffic on the lines of communication, for to build up the reserve therein requires a certain number of trains while the normal military traffic is still coming up from the base to railhead. The cure for the one

cause of failure—length of line—may quite well precipitate the other—overloading the line—unless forward demands from the field army are reduced temporarily.

The capacity which must be set aside for the purpose of building up reserves is large, and its amount is apt to be overlooked, especially if that reserve is required to be built up rapidly. It will be found that, if the communications are capable of maintaining a total of X divisions and Y weeks reserves for that number of divisions are required to be built up in N weeks, then the number of divisions that can be maintained during the period of building up the reserve is—

$$\frac{N-Y}{N} \text{ multiplied by } X.$$

Although we have been considering the question of the movement of stores by rail, similar principles apply when inland water transport takes the place of railways, or is used in conjunction with them.

In ports whose depth of water is not sufficient for large ships to be berthed they must lie off the coast or in the harbour, and the cargoes must be transferred to lighters. Our big ports do not suffer from this disadvantage, but it is a point to consider in connection with small ports which may become important in war. The lighterage equipment of such places must be sufficient to meet requirements, or it must be provided. Lighter work in harbour is one branch of inland water transport work, forwarding goods by river or canal into the interior is another.

The object of lighter work in harbour is to facilitate the loading or unloading of ocean-going shipping not provided with wharf accommodation, or as a supplementary service to hasten the unloading of ships at wharf-side. This lighter work requires careful organization, like any other service, but it is primarily a technical matter for the Inland Water Transport Director, and beyond general assistance in meeting the requirements of the service, the movement staff officer is not likely to

be very much concerned with it. When, however, we have a Mesopotamian campaign or a Nile Expedition to deal with, where our lines of communication depend for the most part on inland water transport, then the soldier will find ample scope to exercise his ingenuity in dealing with the many problems which are likely to arise.

There is a great deal in inland water transport work which is highly technical, both in operating the fleet and in the preservation of the waterway, and this branch of the subject must be left in the hands of the technical expert. Success in operating depends largely on good time-tables; these time-tables are affected by tides, the opening of low swing bridges over canals, the number of tugs available—which number is rarely, if ever, sufficient—and the requirements for care and maintenance of the waterway, which is easily thrown out of gear by floods, low water, weeds or silt. The preparation of the time-table is better left to the technical man, but co-ordination in the common interest, especially where bridges are concerned, will often have to be undertaken by the movement staff.

The subsequent distribution of stores in front of railhead, which is usually a subject of local rather than of general administration, will be dealt with in later chapters when considering the questions of road transport and of maintenance.

6. Railheads.

In the preceding sections frequent reference has been made to railheads. The purposes they serve and the factors governing their selection and use will now be considered.

Railheads are the points on a railway system at which the requirements of the force in the field are delivered, for conveyance thence by other means of transport, and through which what is not required is evacuated to the base or other destinations. The output of a railway system is limited by the capacity of the railheads

to deal with the traffic; any congestion at these points will seriously limit the output of the system as a whole. Care must be taken, therefore, to ensure that clearance facilities are provided on a sufficient scale to balance the reception facilities or to meet the quantities of goods that it is proposed to deliver at the railhead.

The chief commodities that have to be handled at railheads are—

- (a) Ammunition.
- (b) Supplies, including petrol, mails and ordnance stores.
- (c) Personnel—*i.e.*, reinforcements, prisoners-of-war, leave personnel and troop movements generally.
- (d) Ambulance trains.
- (e) Road stone.
- (f) Tanks and heavy artillery.
- (g) Remounts and sick or wounded horses.
- (h) Gun replacements.
- (i) Engineer stores, such as timber, hutting material, bridging and similar appliances.

Some of these commodities are matters of daily supply, others are only required at intervals, but each type has its own special requirements, which should be considered when selecting and allotting railheads for the service of the various formations in the field. When facilities are adequate many of these commodities can conveniently be handled at the same railhead, but ammunition should invariably be allotted a railhead to itself. In future, when petrol may have to be dealt with in bulk and in very large quantities, also on account of its dangerous nature; it may be found desirable to work it at a separate railhead; under present conditions, however, petrol is most conveniently dealt with as one item of supply, and is handled at supply railhead in consequence.

During the war the French system of arranging

railheads—in the early stages, at any rate—was to allot one large station to each formation for all purposes ; while the British system was to allot various stations for the different natures of commodities. The latter system is considered to be generally the best ; the French system is sometimes unworkable. Congestion is less likely to occur when several railheads are used for each formation, and the effects of bombardment from the air, or by long-range guns, are lessened when all the eggs are not put in the same basket. Multiplication of railheads is, however, to be avoided. It produces more points requiring protection, necessitates additional staff organization for control, and may add to the technical railway difficulties as well. When very large and highly developed stations exist it may be possible and convenient to work two or more distinct railheads in different parts of the same station, but this will seldom tend to smooth working in practice.

Congestion, or disorganization, of the railhead itself, apart from the effect of enemy action, should only occur if the railhead has been badly organized.

Causes might be—

- (1) The attempt to make one station serve too many purposes—*e.g.*, for too many formations or for bulk as well as pack train traffic.
- (2) The attempt to avoid railhead dumps by keeping trains as *en cas mobile* while drawings were made in detail from them.
- (3) Keeping too small an area as a reserved transportation area at the railhead, or placing railhead dump sites too close to the station.
- (4) Neglect of road traffic organization in front of railhead.

All these are questions requiring the attention of the movement staff, and they clearly call for very close co-operation with the technical transportation people as well.

When operations are very mobile demands are less, and fewer railheads are required ; larger numbers of commodities can then be dealt with at the same railhead. But as soon as operations stabilize demands of all kinds increase, and, for static warfare conditions, railheads will normally be required on the following scale :—

- (a) Ammunition. One per corps. Must be separate.
- (b) Supplies, mails, ordnance stores. One per corps.
- (c) Personnel. Depends on circumstances ; for strategic moves, three in each army or corps area. Small numbers of personnel can be dealt with at supply railhead.
- (d) Ambulance. One to each group of casualty clearing stations—say, one per corps.
- (e) Road stone. Two special sidings per corps.
- (f) Tanks and Heavy Artillery. Depends on circumstances.
- (g) Remounts. One per army.
- (h) Gun replacements. One per army.
- (i) R.E. stores. One siding per corps.

Railheads are normally selected in the first instance by Army Headquarters, in consultation with corps and divisions in the case of supply, personnel and ammunition railheads, but subject to ratification by G.H.Q., as railways, and consequently railheads, are a subject of general administration. Any officer may, however, be called upon to carry out a reconnaissance with a view to selecting a railhead, and the factors which influence their selections should therefore be fully understood. These factors are—

- (a) The railhead should be suitable for the particular purpose for which it is selected.
- (b) The railhead should be convenient geographically with a view to the reduction of road transport.

(c) The security of the railhead from ground and air attack.

(d) The possibility of its retention unchanged as long as possible.

As regards the desiderata of the different natures of railheads, the following points should be considered, though cases will often arise in practice, especially in undeveloped countries, where these requirements will not be forthcoming unless they are constructed by the army itself :—

An ammunition railhead should have sidings capable of taking the complete standard ammunition train at one time—that is, a siding 390 yards long. This is not so essential in the case of supplies, as the different sections of the supply pack can conveniently be dealt with in separate sidings, or one after the other.

The station yards should provide a minimum width of 40 feet of hard surface for the use of mechanical transport loading from the railway trucks. To construct such a yard, when this is necessary, sufficiently large to clear a complete ammunition or supply train will require 3,000 tons of road stone and the use of heavy rollers to make it; the time and labour involved is the measure of the time necessary to construct such a railhead.

Engineer stores and road stone, owing to their bulk and weight, are usually off loaded on to the ground; this blocks the siding for other loading purposes until the stones have been removed by road transport.

Platforms are not essential, but they are a convenience, especially for loading ambulance trains.

End loading facilities are practically essential for tanks and heavy artillery.

As regards the geographical location of railheads, it is desirable to have them as near the troops they serve as possible, consistent with their safety and the avoidance of road congestion, which might arise if too many formations were using the same railheads or the same roads to and fro.

With road transport as at present organized, railheads should not normally be farther from delivery point (Unit 1st Line Transport) than a maximum of fifty miles. In conditions of static warfare they might reasonably be within twelve miles of the delivery point. They should, in any case, be beyond the range of the enemy's long range artillery. With the increasing efficiency of bombing attacks from the air, it will become necessary to provide efficient anti-air defence for railhead areas. The establishment of such defences necessitates considerable layout of communications, etc., and the tendency in the future will therefore be, more than ever, to avoid moving railheads; so we may expect to find them at times at extreme distances from the formations they serve.

Other points which are of considerable importance in connection with railheads are the entrances and exits from the station yards, the road facilities in the area, and the existence or otherwise, in the vicinity, of parking places for mechanical transport and forming up places for troops and their first line transport. These and other requirements are summarized in Appendix 2 at the end of this section.

The military organization at a railhead will consist as a rule of the following personnel :—

- (a) A movement staff officer whose primary duty it is to act as the channel of communication between the troops and the technical railway staff. It is through him that the military requirements of the situation are notified to the railway service.
- (b) A railhead supply officer (R.Sup.O.) whose duty it is to receive the contents of the supply pack train on its arrival at S.R.H. and to issue the supplies to the supply officers of the various Maintenance Companies.
- (c) A railhead ordnance officer (R.O.O.), who performs similar duties to the R.Sup.O. as

regards ordnance stores, or has technical ordnance charge of an ammunition railhead.

- (d) A representative of the Military Forwarding Service (M.F.O.), who deals with the various small consignments, parcels, kits of wounded officers, etc., passing through supply railhead.
- (e) A railhead post office, normally controlled by a sergeant.
- (f) A railhead supply detachment working under the R.Sup.O. at S.R.H.
- (g) A section or more of an ammunition company, R.A.O.C., working under the orders of the R.O.O. at A.R.H.
- (h) A labour officer and labour units as necessary for handling goods in transit.

The rules for working railheads are simple but important, their object being to prevent congestion occurring at the railhead. When there is any possibility of extensions of existing facilities becoming necessary, a reserve transportation area should be set aside for the purpose, all traffic being removed clear of this area.

Station yards should be kept clear, no transport being allowed to enter them until a train arrives for loading or unloading. Punctuality of loading parties and transport must be enforced.

No dumping of stores or ammunition should on any account be allowed on station premises. Small accumulations of ammunition and stores in the vicinity of railheads cannot be entirely avoided, owing to changes in the situation in advance of railheads, and consequent fluctuations in demands. The greater the distance between railheads and final delivery points, the greater do these accumulations become. It is of the highest importance to keep these railhead dumps to a minimum. The proper place for such accumulations is in the depots adjacent to the regulating station. When railhead

depots are formed, they are in charge of the representative of the services concerned.

At railheads where personnel is dealt with, reception camps should be available within an easy march of the station.

Where remounts are dealt with, special facilities may have to be provided by way of portable ramps and cattle pens.

Regulating Stations.

We will pass now to the question of Regulating Stations, which fulfil most important functions in the railway working of the line of communication. It is at the regulating stations that the train loads of different commodities coming, perhaps, from widely scattered bases and dumps, are received, broken up and reformed into various supply pack trains, which are then forwarded to the correct railheads. Railheads may alter constantly in accordance with changes in the tactical or strategical situation, and it is important to ensure punctual arrival of the trains at the correct railheads.

It is at the regulating stations, too, that the return traffic from the front is received. This traffic consists of a great variety of types such as mails, kits, empty ammunition boxes and petrol tins, sick horses, damaged stores and vehicles for repair, and salvage of all sorts. These items are sorted in the regulating station, and sent on to their correct destination, and from here, too, the distribution of empty rolling stock to the various depots for reloading is carried out.

All this work necessitates the handling of very large quantities of rolling stock, which has to be shunted and marshalled into trains. Possibly upwards of 480 trucks both ways will be dealt with in twenty-four hours. Large stations with ample shunting facilities are therefore required, or new marshalling yards may have to be constructed for the purpose, which requires a considerable area of flat ground.

The primary rôle of the regulating station is to ensure

that trains arrive at the railheads at the correct times, and containing the correct goods in the proper quantities required by the units and formations which, for the time being, receive their needs through that particular railhead. To ensure the exact performance of this rôle, it is necessary that regulating stations should be located within the limits of from six to twelve hours' run of the respective railheads.

Apart from the duty of giving final directions as to destination of individual trains, a great deal of work is done at the regulating station in marshalling trucks received from various depots, and even in adjusting the contents of trucks, to meet changing situations in the formations in advance of railheads. For the efficient performance of the above duties, it is practically essential that there shall be, in the vicinity of regulating stations, depots containing the various natures of commodities required by the forces in the field.

From the above considerations two different situations may arise. If the length of the L. of C. from base to railheads is short—*i.e.*, not much in excess of twelve hours' rail haul, we may find that the function of the regulating station is performed in the railway marshalling yard in which trucks coming from the various base depots (ordnance, supply, etc.) are assembled. Trains, both of pack stores and bulk stores, may be assembled here and dispatched direct to their final destination; the base marshalling yard thus becomes the regulating station also. If, however, we have a long line of communication, changes in the distribution of units and formations and in their requirements will arise while trains are in transit on the line of communication. Thus it becomes necessary to have a regulating station within a comparatively short haul of the railhead, where the necessary adjustments can be made, supplies be augmented or reduced, and unit stores be re-assembled for new destinations. It is this latter fact which gives rise to the necessity of having, in the vicinity of the regulating station, depots which

can receive surplus stocks or make good deficiencies arising from changes in the situation in the forward area. A group of such depots forms an advance base, which frequently holds, not only the small margin of stores to meet the fluctuating circumstances, but also a fixed scale of reserves of all natures of stores as may be ordered by the C.-in-C. In these latter conditions all movements between the base and the advanced base may be by bulk stores trains, and issues against indents may be made from the advanced base.

The three primary functions of the regulating station are therefore—firstly, to build up the pack trains; secondly, to ensure that the pack trains arrive at the correct railheads at the right time; and, thirdly, to distribute the return traffic to the correct destination. It will be obvious, too, that they fill very important functions in the general regulation of railway traffic.

APPENDIX 2.

POINTS FOR CONSIDERATION IN RECONNAISSANCE OF RAILWAY STATIONS.

1. Approaches.

To the station, general road and traffic facilities, and forming up places for troops and M.T. in the vicinity.

Entrances and exits to and from the station yard.

Any special traffic difficulties, such as level crossings or bridges.

Entrances to and exits from platforms.

Possible effect of bad weather on approaches and forming-up places.

2. The Yard.

Size, shape and condition of surface. Facilities for M.T. unloading trains. Minimum width to serve one train, 40 feet; to serve trains on either side, 60 feet. A very good and strong surface required for continuous use of yard in bad weather.

3. The Line.

Single or double or more through lines. Main—junction or branch.

4. The Sidings.

Total length; length with road approach; length without road approach—*i.e.*, holding or garage sidings. Turntables.

Length opposite each end loading bay.

Lengths are best given in truck capacity clear of cross-over points (four-wheeled truck measures 28 feet over buffers, therefore 10 trucks require $93\frac{1}{3}$ yards—say, 10 trucks 100 yards for safety, or 10 yards a truck).

Lengths between crossing loops in sidings and on running lines. Shunting facilities. Marshalling yards. Facilities for extension.

5. Platforms and Unloading Bays.

Length, breadth, height, number; suitability for tanks, heavy artillery, transport, horses, ambulance purposes; exits and entrances.

6. Miscellaneous.

Station buildings for offices; goods sheds; cranes and their capacity; lighting facilities; water facilities for engines and in station buildings. Latrine accommodation. Entraining facilities such as ramps and horse brows; fuel and repair stocks.

7. Vulnerability to Air Attack.

Any points such as comparative conspicuousness, conformation of ground.

8. General Points.

(a) A sketch plan almost an essential part of a reconnaissance report; scale, say, 60 yards to 1 inch, showing station, yard, sidings, road approaches, etc.

(b) Report should give general description, and should state facilities for extension and type of traffic for which best suited on lines of requirements in next

paragraph, and having regard to tactical considerations in addition.

9. Types of Military Requirements.

(a) *Troop Movement*.—Trains of 50 vehicles and engine ; total length, 470 yards. Platforms not essential if portable vehicle and horse ramps available. Simultaneous loading of animals, vehicles and personnel desirable.

(b) *Supply Railhead*.—Normally pack train consists of two sections, each 16 to 17 trucks. Each section requires 170 yards of unloading frontage on the yard plus garage siding for remainder as a minimum.

(c) *Ammunition*.—Trains normally 37 to 39 trucks ; requires, say, 400 yards of unloading frontage on yard for simultaneous unloading throughout length of train.

(d) *Ambulance*.—Train requires 300 yards of loading frontage, and platforms are a great assistance.

(e) *Tanks, heavy artillery and M.T.* must have end loading facilities.

(f) *R.E. material and stone* require 400 yards of siding of any type, but must have good removal facilities for stores or stone.

N.B.—No loading or unloading should be allowed on the main through running lines.

CHAPTER III

MOVEMENT OF TROOPS.

Section 1. Movement by Strategical Train.

VON MOLTKE, in 1866, was the first person to make use of railways on the grand scale for troop movement in war, and by their means he concentrated the Prussian Army in twenty-five days for the war against Austria. The use of railways for troop movement during the Great War was very considerable, and, as a result of the experience then gained, it has been found possible to standardize the system to a large extent.

In so far as the British Expeditionary Force was concerned, the two most important railway moves carried out in France were: firstly, the move of six divisions and one cavalry division from the Aisne to the Lys in October, 1914, a distance of 120 miles in eleven days; and, secondly, the move of five divisions from France to Italy in November, 1917, a distance of 700 miles in eleven days.

For purposes of illustration the move of the 3rd German Reserve Division from Angerburg to Allenstein in August, 1914, may also be quoted. This division was in action in the Blenkheim area on the morning of August 21st, it marched distances of from thirteen to twenty miles to the entraining stations, travelled seventy-nine miles by rail and was detrained complete by the night of the 23rd, the railway move taking forty-eight hours. This represents a very quick move. The point to notice in connection with these moves is, that the actual time spent on the rail journey is small in comparison with the time taken to entrain and detrain. Although many hundreds of individuals can entrain in

London in the morning, attend the Grand National, nearly two hundred miles away, in the afternoon and return by rail to London the same night, it is quite another matter to entrain a large body of troops with their horses, vehicles and impedimenta of all kinds.

So we find that, when forces of the size of a division or more have to be moved, it is quicker to move by road than by rail, if the distance is less than sixty miles in the case of a division, or ninety miles in the case of a cavalry division. Beyond these distances the advantage lies with the railway move. There remains the alternative, for moves of comparatively short distances, of using a combination of rail and road movement, dismounted personnel going by train, mounted personnel and transport by road; or, again, motor transport can be used for moving the dismounted personnel. Provided the formation moving is not very large—that is to say, a division or less—this combination of methods is the quickest way of moving for distances involving a march of less than three days, though there are certain drawbacks in its use, which will be dealt with in a later section.

Thus, we have three methods of troop movement, which will now be considered—

- (i) When units move complete by train with their animals and transport. This is known as movement by *Strategical Train*.
- (ii) When the dismounted personnel of units move by rail with a minimum of their transport, the remainder going by march route. This is called movement by *Tactical Train*.
- (iii) When the dismounted personnel moves by road in buses or lorries, and the remainder marches. This we will call movement by *Mechanical Transport*.

When a division is moving by strategical train, the mechanical transport of the division will move by road or by rail, according to the distance which has to

be covered. Thus, for a move from France to Italy, the M.T. went by road, but for a trans-continental move it might be better to send the M.T. by rail also.

Rate of Movement by Rail.

It has been pointed out above that a division can move sixty miles, that is three long marches, as quickly by road as by rail. That is to say, it takes nearly three days to move a division sixty miles by rail. It would only take four days to move it six hundred miles by rail. Within limits, then, it is not the distance which is the deciding factor. Why does it take so long to carry out the move of, say, a division by rail ?

One reason is to be found in the time taken to entrain and detrain, another lies in the limited number of trains that can be run over a given stretch of line in a stated period of time.

As regards the first of these reasons, different railway stations vary considerably in the facilities they provide for the entrainment and detrainment of troops ; again, they vary in their facilities for shunting and marshalling the trains. Before a second train can be placed in position for loading or unloading, the previous train must be hauled clear of the sidings ; the yards also must be cleared of one lot of troops and their belongings before they can be used by another train load, for congestion in the railway premises and in the approaches to them must not be allowed to occur, or delay is inevitable. When allowance has been made for these considerations, it has been found in practice that three hours is required for entrainment or detrainment from standard troop trains. It follows, therefore, that a maximum of eight troop trains can be dealt with in twenty-four hours at any one entraining or detraining point.

It may be possible to find more than one entraining point in the same railway station, if it is a very large and well-equipped place ; but in order to avoid congestion, and for the greater convenience of the troops

with regard to billeting accommodation, it will generally be preferable to select entraining and detraining places a few miles apart. Besides, it is always advisable not to put too many eggs in one basket ; an accident may cause delays, or blocking of one entraining point, and there is also the possibility of hostile air attack to be borne in mind. So, if we assume three points for entraining and three for detraining, it will be seen that not more than twenty-four troop trains can be dealt with in twenty-four hours. More than three entraining points, can, of course, be used if desired, but in view of other considerations, which will now be explained, it is open to question whether any appreciable advantage will be gained thereby.

As regards the second reason for the length of time required to carry out the movement of troops by rail, every railway system has its maximum rate or density of movement—*i.e.*, the maximum number of trains it is possible to run over the system both ways in a period of twenty-four hours. The figure depends on a number of considerations, mainly of a technical nature ; for example, it depends on whether the line is single or double, on the length of the block sections, on the amount of rolling stock and engine power available, on the gradients, marshalling and shunting facilities, etc. On some British railways a maximum density of 144 trains in twenty-four hours has been maintained for troop movement, but this has meant the entire suspension for the time being of all other railway traffic. During operations in war time, the troops who are still in action during the period of a troop movement by rail have got to be maintained as usual. It may or may not be possible to suspend entirely all civil traffic, and for either strategical or tactical reasons certain lines may not be available.

Taking all these factors into consideration, it has been found in practice that, even on highly developed continental railway systems, the maximum rate for the strategic move of any individual formation, such as a

division, can be accepted as twenty-four troop trains of the continental type in twenty-four hours. On a single line the rate of movement, for technical railway reasons, is very much less and may not exceed eight trains in twenty-four hours.

Uniformity of running speed is essential, and in practice may be taken as from seventeen to twenty miles an hour. On the above basis the time necessary to carry out the strategic move of a force by rail over a given distance can be calculated ; and it will be found that the number of hours required is approximately determined by the number of trains, plus entraining time (three hours), plus detraining time (three hours), plus running time for the journey. It takes in or about forty trains of the continental type to move a division. If we apply the above formula to the move of the five British divisions from France to Italy in 1917, we get $5 \times 40 + 3 + 3 + \frac{700}{17} = 248$ hours, or ten days and eight hours.

The actual movement was completed within eleven days. It will now be clear that, under normal conditions, we can expect to run twenty-four continental type troop trains over a stretch of double line between any two points in twenty-four hours, and this rate of movement can be met by the use of three entraining and three detraining points ; an increase in the number of the latter is not likely to speed up the movement as a whole.

As regards the method of moving troops by rail, there are two distinct systems—the British and the continental.

In the British system the composition of the train is adjusted in conformity with the type of unit to be moved.

In the continental system a standard type of train of fixed composition is used for all units, with the exception of tank units, heavy artillery, or units equipped entirely with mechanical transport requiring special types of trucks.

The whole experience of the war was in favour of standardization and the adoption of the continental system, and even in this country the number of type trains used for troop movement was finally reduced to five.

In a war of any magnitude outside the United Kingdom, it is practically certain that the continental system, with its one standard type of train, will invariably be used in future. The actual composition of the standard type train may have to vary somewhat to fit the particular nature of the theatre of war, engine power, gauge, ruling gradients, and so on ; but the type finally adopted in France, to the exclusion of all others, was a train of fifty vehicles—called the omnibus type—and it had—

- 1 coach (first or second-class) for officers (30 officers).
- 30 covered vans, each taking 40 men or 8 horses (6 H.D.).
- 17 flat trucks averaging four axles per truck. (Three axles in the case of four-wheeled vehicles, four in the case of two-wheeled or limbered vehicles.)
- 2 brake vans for railway personnel only.

Total vehicles : 50.

A train of this composition will carry a battalion of infantry, less one rifle company, a regiment of cavalry, or a battery of artillery complete with personnel, animals, guns and vehicles. And thirty-five to forty trains of this type are required to move a division, while seventy to one hundred and eighty are required on the British system.

The standard type trains adopted in England were much smaller, being made up to carry such parts of units as half a battery of artillery, a squadron of cavalry, half a battalion of infantry and such like. The average running speed of the English trains was twenty-five miles an hour, while in France it was seventeen miles an hour.

The relative advantages and disadvantages of the two systems may be summarized as follows :—

The continental system admits of a number of trains, the carrying capacity of which is a known factor, being held ready in garage ; a move can, in consequence, be initiated and completed in a minimum time and with a minimum of preliminary notice, and the time necessary for making the move can be exactly calculated. This, of course, is of great value in military operations, and increases the possibility of effecting strategic surprise. It may be argued that this could also be done in connection with the British system, but in this case the trains are not interchangeable, being made up to suit the requirements of certain units only. The British system also requires a large amount of passenger coaches, which are difficult to come by in sufficient quantity, and the time taken to assemble and marshal the train is considerably longer. The British system has the advantage of not breaking up units, and it ensures greater comfort for the troops, but it results in serious loss of carrying capacity in the railway system as a whole. In the continental system of fixed type train, to ensure the maximum use of carrying capacity, the breaking up of some units is unavoidable, and the comfort of the troops is distinctly less.

On the whole, the advantages of the continental system—interchangeability, economy in marshalling time and running capacity, the known number of trains required for any formation that it may be desired to move, the facilities for effecting surprise—far outweigh the disadvantages, and it is probably the only practical method of working when large forces are involved.

Procedure for Strategic Rail Moves.

The orders for a strategic move by rail will be initiated from G.H.Q. and issued by the General Staff in consultation with the Movements branch of the Q.M.G.'s staff. Similarly, in the lower formations the executive

order for the move will be issued by the General Staff, the detailed arrangements being made by the Q.M.G.'s branch. The orders issued by the General Staff would include a warning order if necessary, the executive order for the move, the arrangements for A.A. defence during movement, and any orders required for tactical movements on detrainment. Based on these orders, the Q.M.G.'s branch of the Staff of the formation concerned works out the detailed arrangements for allotting units to trains, and issues all instructions required in connection with the entrainment, detrainment, and procedure during the move. An officer of the G.H.Q. Movement Staff will normally be detailed to supervise the arrangements; he will be the medium of communication between the troops and the railway authorities. His duties will also include ensuring that the necessary facilities are provided by the railway authorities by way of ramps for entraining vehicles and animals, and for bridging the space between trucks when end loading is being used. He will see that the necessary arrangements are made *en route* for any halts required for watering or feeding. He is responsible for notifying all concerned of the dispatch and anticipated arrivals of the various troop trains. He arranges, when necessary, for any special lighting required at entraining and detraining points. It is his duty to ensure that the most effective military use is made of the railway, and that the technical working of the railway is not hampered by the troops. The troops themselves are responsible for the actual loading and unloading of animals, vehicles and stores. This work, however, is very much facilitated if experienced working parties can be made available to assist.

We have now seen how a move of the nature we are considering is initiated, and the division of responsibility for carrying it out. The next point to consider is the detailed organization and the administrative instructions that are necessary. In this connection the first requirements are—

(b) Specimen Form of Serial Number Table.

TABLE OF SERIAL NUMBERS.

1 Div.

*Serial No.**Description of Unit.*

DIVISIONAL TROOPS.

101	H.Q. 1 Div.
102	1 Div. Sigs. (less 146 to 153, 156, 166, 176).
103	H.Q. R.E., 1 Div.
104	Fd. Park Coy. R.E.
105	1 Fd. Coy. R.E., less 106.
106	4 L.G.S. Wagons and teams 1 Fd. Coy. R.E.
107	2 Fd. Coy. R.E.
108	3 Fd. Coy. R.E., less 109.
109	3 L.G.S. Wagons and teams, 3 Fd. Coy. R.E.
Etc.	Etc.

(c) Specimen Form of Time Table.

TIME TABLE RAIL MOVEMENT.

1 Div.

*From Entraining Stations.**To Detraining Stations.*

A. NUNEATON.

X. ANDOVER.

B. COVENTRY.

Y. WHITCHURCH.

C. SHUSTOKE.

Z. FULLERTON.

Detrainment Regulating Station : MARLBOROUGH.

Train Nos. from Stations.			Serial No. of Unit.	Day	Route.	Time of Departure.	Train due to arrive at Station.			Day
A.	B.	C.					X.	Y.	Z.		Oct.
1			157	28	BIRMINGHAM—	0100	0700			28
	2		167	28		0200		0800		28
		3	119, 121, 155, 156, 158	28		0300			0900	28
4			160, 162, 164 ...	28		0400	1000			28
	5		165, 166, 168, 170, 172, 174	28		0500		1100		28
		6	120, 122, 148 ...	28		0600			1200	28
7			159	28		0700	1300			28
	8		169	28		0800		1400		28
			Etc.							

The actual compilation of the Serial Number Table is the most troublesome part. Taking an infantry brigade as an example, it will be found that each battalion, less one rifle company, requires a train. Therefore

give each battalion a serial number and each surplus rifle company a serial number. Then the brigade headquarters and the brigade signal section will each require a number. Thus, we have ten serial numbers for this small formation, and they can be fitted into five trains, four taking the battalions, less four rifle companies, the remainder going in the fifth train. A unit containing many vehicles is more difficult to arrange, on account of the large number of axles involved. The seventeen flat trucks of the standard train will only take sixty-eight axles, or thirty-four limbered G.S. wagons, so this number with their attendant men and animals, is given a serial number. The surplus vehicles of such a unit would be grouped in batches, as most convenient, for fitting in with other small units to make up complete train loads, each batch of vehicles so formed, with its attendant men and animals, being given a serial number. Some breaking up of units is unavoidable in order to make the fullest possible use of the carrying capacity of the trains. Standard tables for the normal formations, such as divisions and brigades, would be prepared by the Movement Staff on the basis of war establishment.

Mechanical transport will normally move by road except for very long journeys. If the length of the train journey exceeds two marches for the M.T. by road, the problem of supply at the destination end may necessitate sending some or all of the second line transport by rail with the troops it serves, unless special arrangements for the maintenance of supply can be made in advance.

As regards the orders that will be required for the troops moving, in addition to copies of the Serial Number Table and the Time Table described above, instructions will be required on a number of other points, of which the following is a summary :—

- (a) Date, time, place of entraining.
- (b) Times of departure of trains, hour at which troops are to be at entraining point (trans-

port three hours before train leaves, remainder of personnel not required for loading one hour before train leaves).

- (c) Route to entraining point, place of assembly and latrine arrangements.
- (d) Destination, duration of journey, route, halts *en route*. (Unless kept secret.)
- (e) Detail of officers in charge of entraining and detraining and how to travel.
- (f) Advance parties, and billeting parties—strength, rations, bicycles, trains on which to travel.
- (g) Detail of loading and unloading parties, from units or a permanent detail. Orderlies and fatigue men at stations.
- (h) Accommodation in detrainment area and action on detrainment.
- (i) Supply arrangements.
- (j) Medical and sanitary arrangements.
- (k) Mechanical transport—command, grouping, route, staging areas, supply.
- (l) Use of lights at night.

In order to maintain secrecy, or to meet changes in the situation arising during the course of a move, it is almost always advisable, especially in the case of a movement over a considerable distance, to select a detrainment regulating station, to which all trains are sent in the first instance, and from which they can be sent on to the required detraining point; in the case of short moves, the rearmost detraining station may serve the purpose.

A.A. defence during railway movements is a matter of considerable importance. Not only may protection be required at entraining and detraining points, but trains in movement, in certain circumstances, offer favourable targets for attack from the air. Available statistics show that about one in three attacks by low-flying planes on unprotected trains was successful; in future, presumably, the danger will be greater, and

arrangements will be required to deal with the possibility. There does not appear to be any great difficulty in mounting light automatics on flat trucks to deal with low-flying aeroplanes, and all units therefore now have the necessary resources at their disposal.

Section 2. Movement by Tactical Train.

In the previous section the general principles governing all troop movements by rail have been considered, and their application in the case of movement by strategical trains explained. Occasions may arise, however, when the movements are tactical rather than strategical, as, for example, when it is desired rapidly to reinforce a threatened area, or when it is advisable to hold tactical reserves farther from the actual battle line, and thus make them more readily available over a wider extent of front.

Other opportunities when railways can help troops in tactical movement occur when roads are very congested with traffic, when troops are very tired, when billeting areas are not available close at hand, or in very bad weather; on such occasions the use of railways to move troops may be of very great assistance. Yet another type of case arises in the event of civil disturbance whether in peace or war. In railway movements of this nature only the personnel of dismounted units travels by rail with an absolute minimum of transport; the bulk of the transport and all mounted troops travel by road.

It will be seen, therefore, that there are certain limitations to the usefulness of this type of movement, the chief of which are as follows:—

- (a) It is not applicable to the movement of large bodies of troops. In the past, moves of this nature have been confined to one or at the most two divisions, and more often to a single infantry brigade, or even to individual battalions.

- (b) Formations on detraining are separated from their artillery and from a large portion of their first-line transport.
- (c) The distance of the move is limited to about forty miles on account of this separation from unit transport.
- (d) The maintenance problem is somewhat complicated during the progress of the move.
- (e) In order to make the most of the carrying capacity of the available railway transport some splitting up of units is unavoidable.
- (f) The utility of the system depends entirely on the geographical situation of the railway line, and the entraining and detraining points available.
- (g) Finally, we must not lose sight of the fact that troops in movement by rail are very vulnerable to attack from the air.

From the above it will be seen that movement by tactical train has definite uses and limitations. Its employment will probably be more frequent during periods of comparative stabilization, though it is by no means impossible during mobile operations, and it may be of great value in effecting surprise concentrations. Moves of this nature have very little effect on the pace of movement of large formations. For purposes of big concentrations for battle, if railways are to be employed, movement by strategical train must be resorted to. Tactical train moves are very well suited to the movement of tank units and also in cases of internal disorder, as in the latter case artillery is rarely, if ever, required, while second-line transport, and to a large extent first-line also, can usually be dispensed with, large quantities of ammunition are not required and the war-time maintenance system is probably not in force.

In order to obtain full benefit from the use of tactical trains, it is essential that arrangements should admit of

a movement by this means being carried out at the shortest possible notice. This will necessitate holding in permanent commission trains of suitable carrying capacity, garaged in convenient centres. In war, however, there is generally a shortage of the rolling stock required to meet all our army's needs. The amount that can be set on one side, and held ready for possible use in this way, must therefore be decided by the highest authority in possession of a full knowledge of all the relevant factors.

As in the case of movement by strategical train, standardization of procedure is the surest method of getting the maximum of efficiency. The standard railway organization for tactical train moves consists in the use of trains in sets of four, three being standard personnel trains, and one a standard omnibus train of the strategical type described in the previous section. A set of four trains of this nature is designed to carry the dismounted personnel of an infantry brigade, brigade signal section, field company R.E., and one company of a field ambulance, with a minimum of transport.

The normal composition of the personnel type train was :—

- 2 (1st or 2nd class) coaches carrying from 24 to 30 officers each.
- 44 (3rd class) coaches carrying 30 men each.
- 2 covered trucks, for stores, bicycles or personnel.
- 2 brake vans for railway personnel only.

—
Total 50 vehicles.

The composition of the omnibus type train is given in the previous section. In some cases the sets of trains consisted of two personnel and two omnibus type.

The detailed loading of the trains will depend on circumstances, for, if units are moving into action, they would naturally take with them by rail the maximum number of fighting vehicles, such as machine-gun, Lewis-gun, and S.A.A. limbers; while, if coming out

of action, travelling kitchens and water-carts might take precedence over vehicles more essential for tactical purposes.

The staff of the formation moving will, of course, issue orders as to what is to be taken by rail and what sent with the road party. The best way to work out the allotment of troops to trains is to start with the omnibus type trains; in them the maximum number of axles that can be carried is determined by the number of flat trucks available. These axles must be accompanied in the same train by the corresponding number of animals and drivers, the remaining capacity of all the trains is then filled with dismounted personnel. Care is, of course, required to ensure that adequate personnel is sent with the road parties to perform the necessary duties *en route*, whether tactical or administrative.

The move of the road party is organized like an ordinary march, and, if the distance is over twenty miles, a halt for the night must be allowed for. The supply arrangements with mechanical transport present little difficulty so long as supply officers concerned are kept fully and punctually informed of the number of men and animals accompanying each party.

A suggested form in which to show the allotment of troops to a set of tactical trains is given below. As pointed out previously the detailed loading, especially as regards vehicles, will depend on circumstances.

As regards entrainment and detrainment, it is sufficient to allow one hour in the case of personnel trains, but three hours are necessary in the case of omnibus trains carrying vehicles and animals.

The number of points used for entrainment and detrainment will depend on the size of the force moving, the rate at which it is desired to carry out the move, the capacity of the line and its geographical position in relation to the areas to and from which the troops are moving. Personnel trains can, if necessary, be loaded and unloaded on an open line, but it is a first principle

of railway work that no loading or unloading takes place on a through working line. The omnibus type trains will require the normal facilities ; that is, a total siding accommodation of five hundred yards, with shunting facilities in addition ; room for at least three flat trucks at a platform, or end loading ramp ; room for at least three horse trucks alongside a platform, or failing platforms, three portable horse ramps.

Points to be Dealt with in Orders.

Orders for this type of move are similar to those required in the case of movement by strategical train, but they can, as a rule, be shorter. The following is a summary of the points which will normally require to be dealt with :—

- (a) Orders for the move, destination, and probable time of arrival.
- (b) Role on arrival, and transport and equipment to be taken by rail.
- (c) Air defence arrangements.
- (d) Number and composition of trains allotted, and detail of troops to trains.
- (e) Road party—command, time of start, starting point, route, staging areas, A.A. defence.
- (f) Maintenance arrangements, ammunition, supplies, baggage, greatcoats, cooking facilities.
- (g) Medical and sanitary arrangements.

Section 3. Movement of Troops by Mechanical Transport.

In considering the question of movement of troops by mechanical transport, it should be clearly understood that this form of movement is akin to movement by rail. It is similar, in fact, in many respects to movement by tactical train. It is not to be confused with the employment on the field of battle of mechanized forces. A completely mechanized force may be employed as such in tactical movements in contact with the enemy, but an infantry brigade moving in buses or lorries is little more capable of tactical evolution

SUGGESTED FORM FOR SHOWING ALLOTMENT OF TROOPS TO A SET OF TACTICAL TRAINS.

Serial No.	Train Type and Number.	Place from.	Time of Start.	Unit Entering.	Officers.	Other Ranks.	Bicycles.	Animals.			Vehicles.	Place to.	Time of Arrival.	Remarks.
								Riders.	L.D.	Pack.				
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(j)	(k)	(l)	(m)	(n)	(o)
1	T.O.1			H.Q. 1 Bde. Sigs. 1 Bde. "A" Bn. "B" Bn. "C" Bn. "D" Bn. 1 Fd. Coy. 1 Fd. Amb.	4 1 1 1 1 1 4 2	12 27 50 50 50 50 100 40	1 6 1 1 1 1 1 1	5 7 7 7 7 7 5 1	2 2 19 19 19 19 2 2	2 6 6 6 6 6	1 L.G.S. wagon 1 L.G.S. wagon 4 L.G.S. Lewis guns 1 L.G.S. S.A.A. 2 L.G.S. M.Gs. 1 Maltese Cart 1 L.G.S. wagon 1 L.G.S. wagon			Formation moving. 1 Inf. Bde. complete. 1 Inf. Bde. Sig. Sec. 1 Fd. Coy. R.E. 1 Coy. 1 Fd. Amb.
	Total in T.O. Train			...	15	379	13	46	84	26	68 axles			
2	T.P.2			H.Q. 1 Bde. Sigs. 1 Bde. "A" Bn. 1 Fd. Coy.	4 1 32 1	25 7 737 100	8 0 11 16							
	Total in T.P.2			...	38	869	35							
3	T.P.3			"B" Bn. "D" Bn.	32 16	737 368	11 5							
4	T.P.4			"C" Bn. "D" Bn.	32 16	737 369	11 6							

The balance of this brigade group would form the road party.

than it would be if moving in railway trucks. It is from this point of view that this form of troop movement will now be considered.

Movement by mechanical transport was considerably developed during the Great War. Both the French and the Germans moved infantry in lorries in support of their cavalry in the early stages. London buses were sent to Antwerp with the Marines in October, 1914. During the defence of Verdun, in 1916, the French used 2,500 lorries to transport an average of 13,000 men and nearly 2,000 tons of stores daily over a distance of eighty-five miles each day, and they maintained their rate of movement with little diminution for a month. This last example was a case of intensive road traffic run on lines closely resembling a system of railway traffic control.

The large area of a modern battlefield makes the existence of a reserve which can be moved rapidly, and without the fatigue entailed by long marches, of prime importance. For such duties as the seizure and consolidation of important points on a line of advance, for wide enveloping movements, and in rearguard work, the value of moving infantry in buses may be very considerable. The combination of two of the first principles of war—surprise and mobility—rendered possible by the use of mechanical transport for troop movement, is a most valuable weapon in the initial stages of an attack, in following up a success, or in a withdrawal. Rapidity of manœuvre is the essence of surprise, and the possibility of moving troops rapidly by mechanical transport must enter into our calculations when making plans of operations.

Before discussing the detailed organization required for this form of movement, it will be well to examine briefly the main tactical considerations which affect the question.

Firstly, there is the fact that few things are more visible, or more liable to attack, by air forces than long columns of lorries, or troops engaged in the processes

of embusing or debusing. The remedies in this particular are to be found in anti-air defences and in the use of movement by night.

Secondly, there is the question of relative pace of movement. With infantry equipped as at present, with horse-drawn first-line transport, a movement by mechanical transport over any appreciable distance involves a separation of units from their first line vehicles, and therefore from part of their essential fighting requirements. In this case the remedy lies in equipping infantry units with mechanized first line transport capable of accompanying them on the line of march, and of maintaining, when necessary, the same speed as the infantry themselves when moving in buses and lorries.

Thirdly, there is the question of maintenance of communication. The greater the pace of movement, the greater the distances that can be covered, and the greater in consequence the difficulties of communication between the various parts of a force. The indiscriminate use of wireless for communication purposes might easily discount the surprise we are hoping to gain by increased mobility. The solution here may lie in expansion of the motor cycle dispatch rider service, and possibly in the use of aeroplanes to assist intercommunication.

Finally, a point which will have to be decided is the distance from the anticipated field of battle at which it will be necessary for troops, who fight on foot, but are carried in M.T., to leave the latter; and, further what is to become of the M.T. vehicles during an operation. The object to be aimed at in considering this last question is to ensure that the troops are not fired on when still in the lorries. Also, unless the nature of the country or the time of year offer good facilities for concealment, the lorries, after unloading, may have to be withdrawn several miles to avoid drawing the attention of hostile aircraft. In this case the infantry must fight without thinking too much of their farther movement by means of the lorry column.

In searching for the solution of the various problems of a tactical nature which affect the question of troop movement by M.T., the greatest difficulty which has so far presented itself, with our present-day infantry organization, is the question of how troops moved by bus can be maintained and fed without their unit transport on arrival at their destination, and how far their tactical efficiency is impaired by the lack of the vehicles which carry their Lewis and Vickers guns.

The use of movement by night has been referred to above. Though the advantage of concealment may be obtained thereby, it must be realized that the pace of movement of large lorry columns during darkness cannot be great. Allowing for essential halts, the pace of movement by day can be taken as an average of eight miles an hour, but at night it would be unwise to count on an average pace of movement in excess of six miles an hour. Quite small columns or individual units can, of course, exceed this rate of movement considerably, but large columns cannot. Much will depend on the roads, and the widest and best roads available should always be allotted for M.T. movements. It should be remembered that driving lorries in big convoys is extremely tiring for the drivers, especially when moving at night.

Organization of Bus Units.

Bus units are not maintained in our army as such in time of peace, but they can be organized in war-time in accordance with requirements. A mere collection of lorries, without the organization indicated below, is unworkable as a means of troop movement. The essential points governing the organization required are as follows :—

- (i) Bus units should contain a suitable number of vehicles to enable them to carry a definite unit or formation, such as an infantry battalion or brigade.

- (ii) They should be of a convenient size for command, control and administration.
- (iii) They require adequate establishments of officers, motor cyclists, workshops, store, baggage and supply lorries of their own, and spare lorries.

If continuous working is required under war conditions, it must be remembered that the wastage is very high and may easily amount to a third of the vehicles being off the road at any one time undergoing repair and overhaul. At least $2\frac{1}{2}$ per cent. of the vehicles actually allotted for the carriage of troops should be earmarked as "running spares."

During the Great War the organization employed was in auxiliary omnibus parks R.A.S.C., consisting of a headquarters, a headquarter company, and six bus companies. Their equipment was partly bus and partly lorry. This formation could transport the dismounted personnel of one division, two bus companies being capable of carrying an infantry brigade and a field company R.E.

Embusing, Debusing and Halting Points.

An important consideration in the movement of troops by mechanical transport is the selection of suitable places for embusing, debusing and for halts *en route*. Whenever possible, sites for these should be carefully reconnoitred in advance. Ideal requirements from the M.T. point of view, would be a long, straight stretch of broad road, with room at the side for troops to form up. Such a site would, however, form a perfect target for attack from the air, and would probably have to be avoided in consequence, and a less suitable site selected for the sake of concealment from observation. For forming up the vehicles the space required for one hundred lorries is 1,200 yards, or a hundred buses 1,400 yards. While running, a minimum distance of 25 yards a vehicle is necessary.

In addition to the site for forming up the vehicles, assembly places are also required for the troops ; these must be clear of the actual roadway. The vicinity of villages or defiles of any sort should naturally be avoided when selecting embusing points. About fifteen to twenty minutes should be allowed for actually forming up the lorries and buses from column of route, and another fifteen minutes are required for embusing the troops. Speed in this is largely a matter of good drill and discipline ; with practice the time taken can be very much reduced, and as many as 3,500 men have been embused in six minutes.

During a movement by M.T. halts are required. These are necessary to enable columns to close up, for rectifying minor engine troubles, and sometimes to enable the engines to cool. On long journeys they are necessary to rest the personnel. The frequency of these halts will depend largely on the nature of the road ; they are particularly necessary during a move by night, when it may be advisable to have them at intervals of about six miles. Whenever possible, halting points should be previously reconnoitred, concealment from air observation should be looked for, and halts should not be on steep hills.

The Bus Route and Control of Movement.

Naturally the route to be used for M.T. movement should be carefully selected, if possible by actual ground reconnaissance. The route should then be piqueted to prevent the possibility of mistakes, as overrunning a turning may entail very serious delay. Motor cyclists are the best for this purpose, and they require a light at night so that lorry drivers can see their signals. If sufficient motor cyclists are not available for piqueting, it may be necessary to send one or two lorry loads of troops in advance of the main column for the purpose, arrangements being made to pick them up again after the rear of the column has passed. It has been found of great advantage, when running over unknown roads,

to give the actual lorry drivers previous instruction in the accidents of the road they are about to traverse.

The question of turning circuits at the end of a journey is one of very great importance. On really good wide roads it is of course possible to turn lorries in the road, and with good drill it can be done in reasonable time; but there are very few roads that will admit of this being done, and in any case a turning circuit is infinitely preferable. In tactical moves by M.T. this point should be very carefully considered, halting places and bounds being selected in view of the use of cross-roads for securing a return route for lorries should it be necessary. Neglect of this precaution may easily result in serious losses.

Within the essential demands of tactics, bus routes should be worked as far as possible like a railway system—embling, debusing, halting and turning places being fixed like the stations on a railway line. For sustained movement over a given stretch of road, this is almost a necessity.

In the actual control of the moving bus column there are two aspects of the question to consider. Firstly, the tactical command; and secondly, the technical mechanical control.

When the movement is for tactical purposes the O.C. troops must always command the column, irrespective of seniority. He will be the deciding authority on all questions such as direction of column, alteration of route, regulation of halts, dousing of headlights, everything, in fact, except the actual mechanical side.

When the movement is not a tactical one, but is merely a quick transport of troops behind the line from one billeting area to another, the mechanical convoy acts like a ferry; the movement is in charge of the senior R.A.S.C. officer, and the duties of the O.C. troops are similar to those of the commander of a troop train.

When the move is a tactical one, steps should be taken to ensure that the R.A.S.C. officers with the bus column are thoroughly conversant with the tactical situation.

The essence of success in carrying out a large-scale movement by mechanical transport is co-operation. The staff of the formation to be moved must consult the senior M.T. officer before the move takes place, so as to ensure that all possibility of misunderstandings is eliminated; there must be the closest co-operation between the staff, the troops, and the bus authorities throughout the movement, and there must be good bus discipline in the troops themselves, if success is to be ensured.

The division of responsibility cannot be fixed on any hard-and-fast lines, as it must vary somewhat with the particular tactical conditions of each case. The general outline of the procedure will normally be somewhat as follows :—

The higher authority ordering the move will fix the embusing points, the time of start, route to be followed, halting places and, possibly, duration of halts, the time of clearing particular points, the final destination, and the anti-air protection of the route.

The O.C. Bus Park will be responsible for getting the buses to the embusing points at the time ordered, for following the route laid down, for running to time, and for the subsequent disposal of the vehicles after arrival at the destination.

The formation moving will be responsible for getting the troops to the embusing point in time—*i.e.*, fifteen minutes before the convoy is ordered to start—for clearing the road to enable the buses to form up (this takes about twenty minutes), for making the actual embusing and debusing arrangements, for clearing the road at the end of the journey for the bus column to move off, for detailing advance parties and guides to precede the main column, and, in conjunction with the O.C. bus unit, for piqueting the route where necessary to prevent mistakes.

It is only by carefully attending to a large number of small points and by training that rapidity and success can be obtained in carrying out M.T. moves on a large

scale. Orders and instructions must, therefore, be very detailed. A summary of the points that will usually require attention is given as an appendix to this section.

As regards the actual procedure for embusing troops, there are two methods which may be used. The first is to embus, say, two battalions of a brigade at a time. The second is to treat the embusing point like the platform of a railway station capable of entraining, say, one unit at a time, then, as each unit moves off in its section of the convoy, another should take its place. Unless the question of concealment from air observation necessitates the use of several embusing points, the latter method is generally the best. Troops to be embused should always be paraded on the running side of the road, unless the route can be closed entirely to all other traffic. On approaching the debusing point, the head of the column should be checked some four hundred yards short, and drivers warned to pull into the side of the road selected for debusing. Unless this precaution is taken, it will be found that on halting the long column of buses the road will be blocked for the passage of other vehicles and troops.

The Road Party.—The similarity between movement of troops by M.T. and movement by tactical train has already been referred to. In the former case, however, the whole of the transport of units must march. Until such time as first-line transport of infantry units is mechanized, this necessitates the separation of units from their vehicles for the period of the march, and consequently limits the useful length of a M.T. move to approximately forty miles, or two days' march for the road party. If this distance is exceeded the difficulties of supply and maintenance become serious, and the tactical efficiency of the unit is also much impaired by the lack of its essential vehicles. If other circumstances admit, it is best to start the road party the day before the bus move, so that it can rejoin its own units on the evening of the M.T. movement, assuming that movement to have been made by day.

The whole aspect of this problem will be changed, if and when infantry units are equipped with first-line mechanized transport, capable of accompanying the fighting troops when moving in lorries. The radius of action of infantry forces will then be very considerably increased.

APPENDIX TO SECTION 3.

POINTS FOR CONSIDERATION FOR ORDERS AND INSTRUCTIONS FOR BUS MOVES.

Suggested form for bus movement table attached.

<i>Points.</i>	<i>Remarks.</i>
1. Warning Order.	Almost always essential for bus moves, as formation moving must co-operate in advance with M.T. officers.
2. Order for move, destination, date and time, route.	
3. Role on arrival at destination.	Unless secrecy precludes this.
4. Air protection.	Air patrols (R.A.F.); A.A. defence units ; Lewis guns in convoy ; what to do in event of air attack.
5. Advance parties (tactical).	
6. Embusing and Debusing points.	Description ; marking of ; signalling arrangements at ; officers superintending. Should be reconnoitred in advance unless quite impossible to arrange.
7. Halting points.	Place ; approximate time ; duration of halt ; any special orders regarding re-embusing at.
8. Sub-division of formations into unit group ; O's.C. Groups and duties. Allotment of vehicles to groups and flagging of first and last vehicle of groups.	<i>Vide</i> F.S.R. Details under 8, 9 and 10 arranged in consultation with M.T. officer. First and last vehicles of each group flagged.
9. Numbering of buses and of parties for each to correspond.	Buses numbered in each group from front to rear. Full number of men detailed for each bus and parties numbered to correspond with bus numbers.

- | | |
|---|---|
| 10. Allotment of embusing points to groups, and flagging. | |
| 11. Detail of spare vehicles. | These are marked "Not to be loaded." |
| 12. Detail of baggage lorries. | Separate lorries for baggage ; always move these in separate column. |
| 13. March table to embusing point. | |
| 14. Time and place of assembly for embusing. | 10 parties for 10 lorries, 120 yards.
10 parties for 10 buses, 140 yards. |
| 15. Embusing and debusing. | Signal for—who gives the order. |
| 16. Equipment. | Worn during move or otherwise.
Disposal of rifles, Lewis guns, etc. |
| 17. Road piqueting parties. Advance parties (Admin.). Guides for billeting areas. | How carried, who commands, when to start. |
| 18. Clearing road at debusing point. | Road must be kept clear of troops till buses have got clear at destination point. |
| 19. March to destination after debusing. | |
| 20. Supply arrangements. | Road party and bus party. |
| 21. Position of bus commander. | |
| 22. Road party. | Composition ; commander ; route halting place ; time of start. |

BUS TABLE (A SUGGESTED FORM).

Serial No.	Formation.	Bus Unit Group and Commander.	Bus Parties.	Bus Nos.	Lorry Nos.	Men.	Total of Unit.	Embusing Point.	Time Personnel due at Em. Pt.	Remarks.
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)
X	X	X	X	XX	XX	X	X	XXXX	X	XX
2	6 Inf. Bde. Group	No. 2 Lt.-Col. JONES R. Berks. (Bus 19)	1 R. Berks. 1 R. Berks. 1 R. Berks. } 6 Fd. Coy. 6 Fd. Coy.	19-36	37-53 54	450 340 { 10 10 180	800 }	Blue flag (100 yds. East of X rds.) at 1st Y in YATELEY Common	0815	Not to use main road marching to embusing point
3	6 Inf. Bde. Group	No. 3, etc.								

CHAPTER IV

THE ORGANIZATION OF ROAD TRANSPORT.

So far, in dealing with the subject of movement, we have been considering "Transportation" rather than "Transport." Transport is the general name given to the various agencies used for moving the army's needs from place to place, while transportation is the system, or science, of utilizing the various types of transport to effect movement on land, on water, or in the air. In this chapter the principles and system of organization of road transport will be examined.

Our normal organization for war includes both wheeled and pack transport, the wheeled vehicles being either horse-drawn or mechanically propelled. But in the various theatres of war in which British troops have been engaged in the past, and may be again, there are many different types of transport to be considered. These types may vary between the Chinese wheelbarrow, the reindeer or dog-sledge of Russia, the ropeway of the Italian mountains, the carrier of the African bush, the yak of the Himalaya, the pack mule, donkey, camel, ox or elephant of other countries. Again, special conditions may call for special improvisation, as in the case of the mud of a devastated area in Flanders, which produced the primitive but efficient means of transport—a bent piece of corrugated iron pulled by a horse.

Experience has proved that the vehicles in general use by the inhabitants in any given district for the ordinary avocations of peace are in many ways eminently suitable for employment during military operations in that district. Consequently, when transport has to be improvised, the vehicles of the country should always be used to the fullest possible extent for military operations in that country.

Principles Involved in Transport Organization.

In planning any road transport organization, there are three main principles which need to be kept in mind ; they are :—

- (a) The organization must aim at keeping transport as fluid as possible.
- (b) The organization must be elastic.
- (c) The organization must be adaptable to meet any needs of the moment.

To consider these principles in greater detail :—

Keeping transport fluid means pooling resources to the greatest extent possible. Every unit must, of course, be provided with sufficient transport for its own immediate needs, but this allotment must be kept to the absolute minimum. All other road transport vehicles should be on the establishment of organized transport units which can be used for general purposes. The nearer the front line, the less fluid transport becomes, but farther back towards railhead the possibilities of pooling increase and should be adopted to the fullest extent possible in the interests of the force as a whole.

Elasticity of our transport organization means capability of expansion or contraction in accordance with fluctuating strengths, and varying demands on its carrying capacity, and of covering varying distances.

It may at times be necessary to introduce an extra echelon to avoid cramping the mobility of a particular force ; conversely one or more of the normal echelons may sometimes be dispensed with and the transport thus released to be made available temporarily for other services. Too rigid a transport organization tends to reduce the freedom of action of a force. Our present organization admits of echelons being readily detached in conformity with any detachment of the fighting units which they are normally designed to serve.

Adaptability of our organization is necessary to meet changing circumstances and the necessity for improvisation. Although a force may begin a campaign with what is considered to be the best form of transport for the particular theatre of operations, it is difficult to foresee all and every circumstance which may arise necessitating the alteration of vehicles, loads and methods. Such difficulties may come from soil, climate, or many other causes, of which the necessity of using pack transport in France and Flanders, and the changes from river to sleigh transport in North Russia are instances.

In conformity with the above principles our transport is organized in three echelons—first, second and third line.

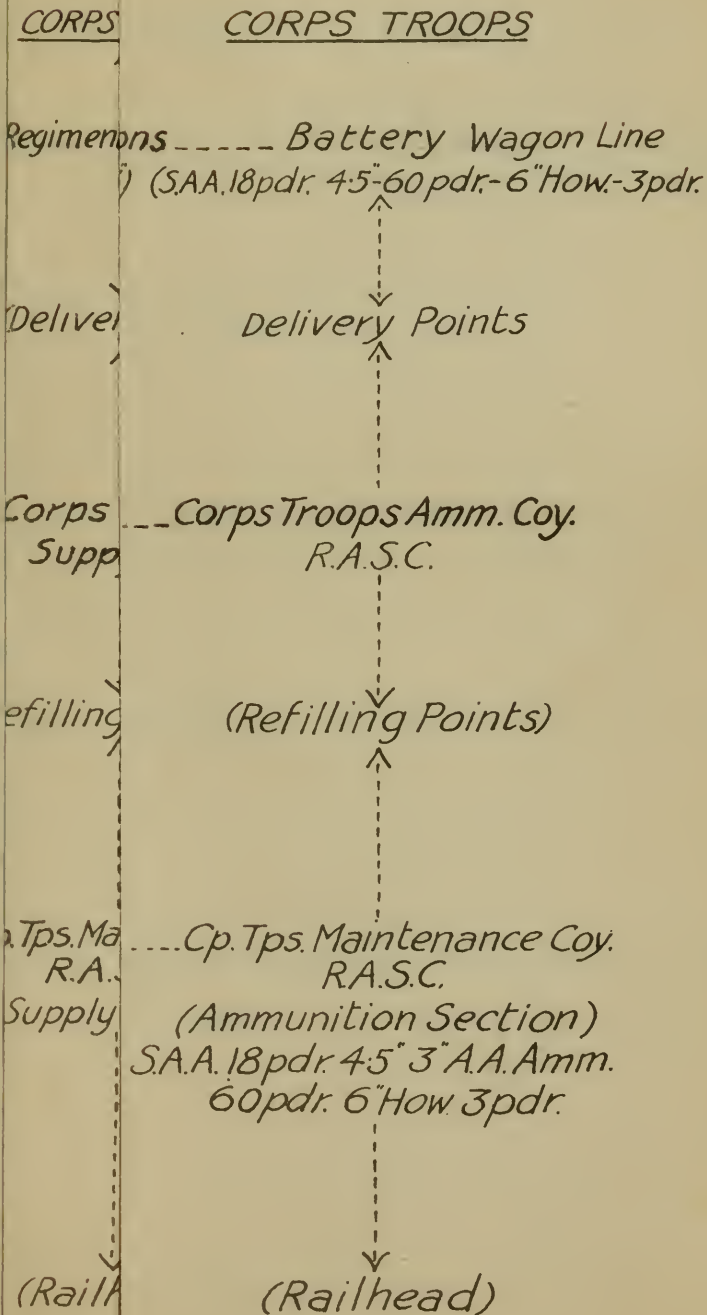
First line, or unit transport, consists of those animals and vehicles which form an integral part of the war establishment of the unit, and which are allotted to it for the carriage of the ammunition, stores and supplies which it requires for its daily needs and for the performance of its normal duties in action.

Second line transport is represented by the baggage, supply and ammunition companies of the divisional, cavalry divisional and corps or army troops, R.A.S.C., which are allotted for the carriage of baggage and great-coats and for the daily delivery to units of the rations, forage, ammunition, ordnance and engineer stores, petrol and mails which they require for their maintenance from day to day.

Third line transport is represented by the Maintenance Companies R.A.S.C., which are provided on a basis of one for each division and cavalry division, and for corps and army troops in accordance with requirements, for the carriage of supplies, mails, stores and ammunition.

The detailed organization and functions of these three echelons of transport will now be further examined.

DIAGRAM. 6.



First Line Transport.

The points to bear in mind in connection with unit or first line transport are that each vehicle has its allotted load and there is no reserve carrying capacity ; consequently, if additional loads are imposed upon it, something else has got to be discarded or temporarily dumped. The vehicles and animals included in unit transport are partly provided for the carriage of essential fighting needs, such as Lewis and Vickers guns and ammunition, and partly for the more creature comforts of the soldier, such as travelling kitchens and water-carts. Although unit transport is normally driven by personnel belonging to the unit, and usually accompanies the unit, it can, when occasion demands, be subdivided into two ; the fighting necessities remaining with the unit, the remainder being temporarily grouped under other command and moving separately in accordance with the tactical requirements of the moment. We find this practice exemplified in the custom of brigading of " B " echelon of unit first line transport of infantry and cavalry brigades during tactical operations.

Second Line Transport.

The detailed organization and functions of second line transport are best exemplified by considering the organization within a division ; the case of a cavalry division is exactly similar, and corresponding provision is now made in the case of non-divisional troops. The R.A.S.C. organization of a division consists of a headquarters and three units—viz., a Baggage Company, a Supply Company, an Ammunition Company. The normal equipment of these units consists of motor vans, light and medium lorries.

The Baggage Company is provided for the carriage of the authorized scale of baggage for all units of the division, and of greatcoats for infantry battalions and field Companies R.E. It is divided into four sections, one corresponding to each infantry brigade, and one for divisional troops.

The Supply Company, which is also organized in four sections, is provided for the carriage of approximately 136 tons of supplies, forage and petrol, 9 tons of ordnance stores, and 3 tons of engineer stores, which together constitute the normal daily requirements of a division. (Total lift, 148 tons.). The normal function of the supply company is to carry supplies from Refilling Points, where they are delivered by the third line transport, to delivery points—that is, to unit first line transport.

The Ammunition Company carries approximately 190 tons of ammunition. It is divided into three sections, each of which carries a proportion of all natures of ammunition used in the division, including S.A.A. grenades and explosives. The ammunition company is equipped mainly with medium six-wheeled lorries.

The normal function of the ammunition company is to carry S.A.A. and grenades between ammunition refilling point and infantry brigade S.A.A. reserves, and artillery ammunition to the battery wagons.

Each of the R.A.S.C. Companies is self-contained as regards breakdown and workshop lorries for maintenance repair purposes.

As regards non-divisional units, such as tanks or medium artillery, these units may be attached from time to time to different corps or divisions, and, as they move from one formation to another, they will be accompanied by their corresponding echelons of second and third line transport, for the carriage of their baggage, and the maintenance of their ammunition and supply services. The second line transport for these units joins the corps troops ammunition, baggage and supply companies of the corps with which the unit is serving for the time being, or, in the event of the unit being attached to a division, their second line transport would be attached to the R.A.S.C. of that division, while their corresponding third line echelon would be attached to the corresponding maintenance company in the corps transport column.

DIAGRAM. 7.

ZATION

2nd Line Transport.

Bagg

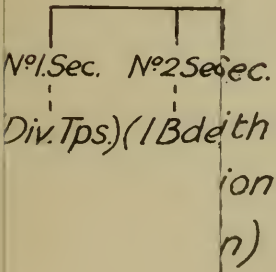
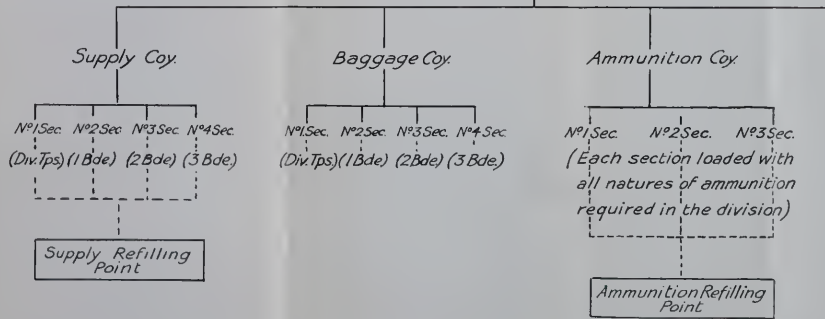


DIAGRAM. 7.

— ORGANIZATION OF DIVISIONAL R.A.S.C. —

2nd Line Transport.

O.C.R.A.S.C.



Third Line Transport.

Third line transport is normally equipped with heavy M.T. vehicles, at the present time the 3-ton lorry. It is organized in maintenance companies, which each have two sections, one for supplies and one for ammunition. The function of the maintenance companies is to work between the respective railheads and the supply and ammunition refilling points, where they hand over their loads to the second line transport. The detail of the system is considered in a later chapter under the heading of Maintenance.

The maintenance companies serving the various divisions are grouped together to form the Corps Transport Column under the Headquarters, Corps Troops, R.A.S.C., who accordingly have at their disposal the following units :—

- (a) Corps troops ammunition, baggage and supply companies (Second Line Transport).
- (b) Maintenance companies for each division in the corps, for the carriage of supplies and ammunition (Third Line Transport).
- (c) A corps troops maintenance company to perform the same functions for all non-divisional units in the corps (Third Line Transport).
- (d) A pontoon bridge park for the carriage of bridging material for the corps.
- (e) An advanced horse transport depot, holding vehicles or complete turnouts for all units with horse transport in front of railhead; includes an R.A. section and an R.A.S.C. section.
- (f) A vehicle reception park for the rapid replacement of mechanical transport breakdowns.
- (g) A reserve M.T. company for emergency and general transport purposes, with a carrying capacity of 250 tons by weight, or 1,700 personnel.

Of the above—(a), (b) and (c) are always included ; (d), (e), (f) and (g) are allotted to corps by G.H.Q. according to circumstances. All the above M.T. units are self-contained as regards breakdown and repair lorries.

The road transport organization outlined above has been evolved as the result of experience gained in the Great War, and was largely brought about by the tactical conditions arising out of the Passchendaele fighting of 1917. During this battle the tremendous development of the enemy's artillery fire, directed in large part on our light railway system, made it impossible for these railways to compete with the task of maintaining the supply of the masses of ammunition, engineer stores, and supplies of all kinds, that the nature of the operations demanded. In consequence it was upon the roads and our mechanical transport that the bulk of the maintenance work then fell.

The strain thus imposed on our mechanical transport soon showed that our existing policy for M.T. organization, under which vehicles and units were specialized for particular services, was not the best one. Early in 1918 a new policy was adopted under which M.T. vehicles were organized into companies for use, under a central authority, in accordance with the requirements of the situation. Many of our former specialized M.T. units, such as ammunition sub-parks, ceased to exist as such, the "pooling" principle was adopted and a central reserve of M.T. companies was formed.

The German offensive of March, 1918, which closely followed our road transport reorganization, showed clearly the advantages inherent in the new system. This offensive was directed against certain vital railway centres behind the Allied front, and the overrunning of such important lateral railway lines as Amiens—Achiet—Arras and the interruption by shell-fire of the line Hazebrouck—St. Pol—Amiens—St. Just interfered very seriously with efficient railway working. Owing to the difficulties of finding return circuits for empty rolling

stock, congestion and delays occurred on the main forward lines, and we were compelled to select railheads far back. At the same time heavy additional demands were made on the railways for stores for the construction of rear lines of defence, for the evacuation of casualties and material of all kinds from areas threatened by the enemy; demands were also made on the British lines for maintenance of French, American and Portuguese troops, and also for feeding civilians. In these circumstances the railways became hopelessly overweighted and congested, and the maintenance of the fighting troops was seriously endangered. The situation was met by the reserve M.T. companies, which had been formed on the reorganization. The work performed at this time by the M.T. companies, and until the Arras—Amiens railway line was regained by our advance in July, 1918, is a splendid record in the annals of the Royal Army Service Corps.

At this time the maintenance of the armies was carried out by long-distance road work performed entirely by mechanical transport, and it would have been impossible, but for the reorganization which had been effected and which had provided the necessary reserve in the hands of the Q.M.G. Not only had the new organization proved its value, but unmistakable proof had also been afforded of the necessity for centralized control of all transportation services under the Q.M.G.

Enough has been said to show that the lessons to be learnt in the organization and employment of mechanical transport, and in the science of transportation generally, are among the most important of the whole war. It is the clear duty of the soldier to study these lessons, to consider their application to possible future theatres of operations, and to note particularly their bearing on strategy and tactics.

Before leaving the subject of the organization of road transport, it would be well to consider some points arising from its radius of action and speed of movement,

as these questions closely affect the whole problem of maintenance, which is to be considered in the next chapter.

On good roads, and during daylight, heavy lorries can maintain an average running speed of 10 m.p.h. when working in convoys ; while the 30-cwt. lorries on pneumatic tyres can average 15 to 18 m.p.h., including short halts. When working at night, in bad weather, or on indifferent roads, these figures must be considerably reduced ; with large convoys under service conditions not more than half the above speeds should be counted on at night.

Under war conditions and allowing time for loading and unloading, cleaning, fuelling and oiling vehicles, and for reasonable rest for the drivers, it has been found uneconomical to run lorries much more than an average of fifty miles a day. This figure can, of course, be exceeded when necessary, and the practical working limits is in or about ninety miles a day for heavy lorries and 130 miles for light lorries on good roads. It must, however, be realized that long journeys cannot be combined with effective concealment from air observation. The military situation will, in consequence, usually be the determining factor in deciding on the maximum distance which can be covered.

The use of two M.T. echelons admits of deliveries of goods being maintained up to fifty miles from railheads without undue strain. This should not, however, be taken as normal, and, generally speaking, delivery points should be considerably less than fifty miles from railhead, if reasonable concealment from air observation is to be obtained. From a consideration of the above points a figure can be arrived at for the distance between railheads and the gun line, or the infantry unit, both for economical working and as a practical maximum, as follows :—

		Economic radius	Maximum radius
3rd Line M.T. Coys.	...	25 miles	45 miles
2nd Line M.T. Coys.	...	25 miles	65 miles
1st Line H.T.	... ..	6 miles	10 miles
Totals	... ..	56 miles	120 miles

With the present-day developments in mechanization we can anticipate that first line transport of the future will consist of mechanically propelled vehicles, whether light six-wheelers, tracked or semi-tracked. This will give a slightly increased radius of action over horse-drawn vehicles, but not a very great increase, as the factors of lateral distribution and cross-country work must be allowed for.

Developments in road transport work with an army in the field bring with them a number of correlated factors for consideration.

The increase in the use of mechanical transport, both for tactical purposes as well as for the work of maintenance, makes an army far more dependent on roads than was formerly the case. Cross-country mechanical traction is, of course, developing along various lines, but roads and road transport still play a very prominent part in the carriage of an army's needs. The increase of mechanical transport necessitates a greater measure of staff control over transport than was the case in the past. The wear and tear on roads are very heavy, and the most careful organization of repair work and of traffic control is essential. The maintenance of roads requires much labour, plant and material. A few *skilled* men can possibly keep a road in repair if provided with the necessary material, where unskilled men would do more harm than good. But once a road has got into a bad state of repair, quantities of unskilled labour, under skilled directions, will be necessary to put it in order again.

The staff can do much to prevent unnecessary wear and tear of roads, by careful organization of traffic

circuits, by arranging separate routes for horse transport and mechanical transport, by ensuring supervision and control to prevent M.T. vehicles proceeding along roads at excessive speeds, by sighting horse lines and water points where animals and vehicles using them will not bring mud on to the roads, and by making provision during periods of hard frosts so that heavy transport may be kept off the roads during the subsequent thaw.

It is in such matters, and in the prevention of waste of transport by reduction of empty mileage, that a good staff organization will add immensely to efficiency. Staff work in connection with transport tends to become more important owing to air developments. An increase of mechanical transport in an area is a sure sign of an increase of fighting troops in this region. Quantities of M.T. vehicles are readily visible to air observers, and the necessity of confining movement of M.T. columns to the hours of darkness is becoming more important, and obviously movement of this nature will necessitate very careful and detailed staff work.

Yet another important consideration is the provision of parking grounds with hard standings for the large masses of M.T. vehicles now included in our army. This has to be borne in mind in all questions of accommodation of troops and control of M.T. units. Cover from air observation, prevention of traffic congestion, and avoidance of empty mileage must all be considered in this connection.

APPENDIX 4.

TABLE TO SHOW THE COMPARATIVE USEFUL LOAD OF DIFFERENT TYPES OF TRANSPORT AGENCIES.

NOTE.—The actual load of any transport vehicle varies enormously with the composition of the load, *e.g.* :—A 10-ton railway truck will carry 10 tons of oats, but only 4 tons of bread or 7 tons of meat. A man can carry 500 rounds of S.A.A., weighing 40 lbs., but only one box of grenades weighing 28 lbs.

In the following table the maximum dead weight loads are given.

Serial No.	Type of Transport.	Maximum useful Load	Relative Mobility.		Daily maintenance food, forage or petrol.
			Rate M.P.H.	Days' March	
1	Native carrier	40-50 lbs.	2½	12-15	4½ lbs.
2	Pack donkey	100 lbs.	1½-2½	12	14 lbs., excluding driver.
3	Pack mule of pony ...	160 lbs.	3	12-15	18 lbs. do.
4	Pack horse ...	200 lbs.	3	12-15	24 lbs. do.
5	Pack bullock	200 lbs.	2	12-15	20 lbs. do.
6	Pack camel ...	320 lbs.	2	12-15	22 lbs. do.
7	L.G.S. wagon	15-30 cwt.	2½	15	48 lbs. do.
8	Light van ...	8 or 15 cwt.	15-25	60-90	2½-3¾ galls. (18-27 lbs.)*
9	30-cwt. lorry	30 cwt.	15-25	60-90	3-4½ galls.)* (22-33 lbs.)
10	3-ton lorry ...	3 tons	10-20	50-90	5-9 galls. (36-65 lbs.)*
11	Dragon as carrier ...	3 tons.	10	45	—
12	Burford semi-track ...	30 cwt.	20	60-90	—
13	Crossley semi-track ...	30 cwt.	20	60-90	—
14	Morris 6-wheel	15 cwt.	30	60-90	—
15	Hathi tractor (hauled) ...	10 tons	15-20	50-90	—
16	Transporter tank ...	3 tons	12	45	—
	<i>Aircraft.</i>			Radius of Action.	
17	Bristol Fighter	224 lbs.	105 @ 10,000 ft.	100	26 galls. †
18	D.H. 9 ...	448 lbs.	114 @ 10,000 ft.	200	36 galls. †
19	Heavy bomber	2,200 lbs. †	93 @ 8,000 ft.	450	80 galls. †
20	Troop carrier	2,200 lbs. †	93 @ 5,000 ft.	120	80 galls. †

* Weight of petrol is for bulk supply—i.e., exclusive of weight of tins.

† Dependent upon amount of fuel carried.

‡ Average over a month.

Supply of troops by air is possible on a limited scale.

Loads up to 120 lbs. in weight can be dropped by parachute.

One "Wapiti" aircraft can carry and drop a load of 800 lbs.

The number of aircraft required to maintain a force of any size, precludes the use of this system for any but quite small forces.

CHAPTER V

MAINTENANCE.

Section. 1 The General System.

“THE art of conquering is lost without the art of subsisting,” said Frederick the Great, in 1786. Seventy years later Marshal Marmont writes: “Men brought together in large numbers have wants; the talent to satisfy these with order, economy and intelligence forms the science of administration.” Yet another seventy years roll by, and the greatest war in history has been fought; the situation remains unchanged. The Commander-in-Chief of the Aldershot Command, in 1926, states: “The provision of food and ammunition is a vital factor in war.” Throughout history it has always been the same; the greatest strategical movements of armies have depended always upon their means of maintenance in food and warlike supplies of all kinds. In the past it was the problem of food supply which mainly exercised the great commanders; now food is only one of the many problems. Ammunition, petrol, engineer stores, repairs, road stone, railway rolling stock, shipping and many other items have assumed an importance in connection with the maintenance of a modern army out of all proportion to anything hitherto imagined.

It is an undoubted fact that, in the concluding stages of the Great War in France and Flanders, none of the armies engaged was better equipped and supplied than the British, not only with the necessities for offence and defence, but also with those things necessary for ensuring a high standard of health and general well-being among the troops. How was this brought about? What are the guiding principles of the system upon which our armies are maintained in war? A knowledge

of these principles and a study of the system are essential ; for, in proportion as the problems are not studied in peace, will our troops and our efficiency suffer in the next war. The admirable results of 1918 were not produced in a day.

The importance of the moral factor in war is well known, but the very large part that good administration plays in fostering morale is not always fully recognized. Good administrative staff work ensuring the timely arrival of the soldiers' needs whether in the form of ammunition, equipment, supplies or any other commodity, produces in the mind of the fighting man the feeling that he belongs to a "good show," that he is being looked after by someone who will not let him down ; in fact, that all is well with the army, and that he can get on with his business of killing the enemy ; he need not worry about his next meal, it will be there all right when he is ready for it. This feeling sets his tail curving upwards right from the start and goes a long way towards ensuring success.

Again, when the hard fighting business slacks off for the time being, and the soldier finds that someone has provided him with a bath, some clean clothes, reasonably good accommodation, cigarettes, newspapers, and letters from home, he will not thank the administrative staff, but, what is far more important, he will be rested and refreshed and generally invigorated, and yet another upward curl will be given to his tail. Good administration, then, plays a big part on the side of morale in war.

The organization of our lines of communication, and the general system of movement along them, have been discussed in an earlier chapter. We will now examine the maintenance functions that the lines of communication perform for an army in the field. These functions are fourfold. In the first place, the lines of communication carry forward the whole of the army's needs in men, animals and material supplies of every conceivable kind. Secondly, it relieves the fighting formations of everything likely to impede their mobility, such as sick

and wounded men and animals, and captured or damaged material. Thirdly, it must maintain the reserves of men and material necessary to ensure the freedom of action of the field army. Finally it, provides the repair installations without which a modern army soon becomes an unwieldy and immovable mass of men.

For purposes of example, if we assume an expeditionary force of ten divisions—ten is taken merely as a convenient figure upon which to base calculations—with its proper complement of corps, army, and L. of C. troops, the daily maintenance requirements of this force will amount to approximately 4,500 tons of stores of all kinds. The provision and transportation of this vast mass of material clearly presents no small problem to those entrusted with the responsibility for the maintenance of our fighting forces. Upon what system are these problems solved ?

As the result of experience in past campaigns a normal system has been arrived at for meeting the daily needs of the fighting forces in the various natures of their requirements, such, for example, as food supplies, ammunition, stores and repairs.

In the case of food supplies, the principle that has been adopted is that field units shall always have with them, or within reach, two days' rations and forage and an iron ration, and that the supply service should keep these stocks replenished by a daily delivery, within reach of the troops, of one day's supplies.

In the case of ammunition the normal system is based on the principle of the automatic replenishment of echelons which are thereby maintained at a fixed establishment.

In the case of repairs, the system is organized into front line repairs carried out in the unit with hand tools, second line repairs carried out in mobile workshops with light power tools, and lines of communication repairs carried out in fixed establishments on the lines of communication or at the base.

This system, though it is called normal, is essentially

elastic. War is abnormal, its conditions are continually changing; the different countries, in which British troops may, from time to time, be engaged, present an infinite variety of conditions, both climatic and otherwise. Enemy action by sea, air or land may temporarily interfere with the smooth working of one or more links in our chain of supply. Our maintenance system must be capable of adaptation to these changing conditions.

The cotton soil quagmires of a Palestine campaign, the mud of a devastated area in France or Flanders, the river communications of Mesopotamia or Egypt, the thick bush, the waterless desert, or the frozen snows of Russia, all call for improvisation and departure from the strictly normal. Changes of system to meet changing conditions have frequently to be made at very short notice. They can only be made successfully where those responsible have a thorough knowledge of the normal system and of the capabilities and limitations of the services concerned. We must know what we have got to improvise and what resources we have at our disposal from which to make the improvisation.

Diagram No. 8 at the end of this section illustrates graphically the system of maintenance. The manner in which the various natures of stores are handled between the base ports and the different railheads has already been explained in the chapter dealing with movement. Some comment may be called for on the functions performed by an advanced base, an intermediate or field supply depot, and reserve ammunition dump, shown in this diagram.

If our line of communication is a long one, and gives rise for this reason to difficulties in maintaining the regularity of supply, or if somewhere on this line there should be some vital point, such as an important railway bridge or tunnel, which might conceivably be blocked by enemy action, bombing or sabotage, then it may be advisable to establish an advanced base in front of the vital point, with its own set of depots containing a sufficient reserve to meet the emergency and from

which the daily maintenance requirements of the formations in the forward area can be provided.

Similarly, when circumstances make it advisable to maintain reserves in the forward areas either to meet unforeseen fluctuations in demands of fighting formations, or on account of possible interruption of the lines of communication, field supply depots are established. Such depots should be on the railway when possible ; they are stocked from the lines of communication and from local resources and they would receive any captured supplies collected in the course of operations. Intermediate supply depots also act as reserves, and form a source of supply for the maintenance of any troops that may be accommodated in the area for the time being.

Somewhat similar conditions would call for the establishment of reserves of ammunition, either in the general railhead area or possibly farther forward in corps areas, should the tactical conditions of the operations make this advisable. Any reserve dumps of this nature would be in excess of the normal field echelons, and the principle of keeping reserves as fluid as possible necessitates their control being in the hands of the higher formation commanders as long as possible. In accordance with this principle, ammunition reserves might be established in control of army headquarters in the railhead areas, such reserves being railway fed. Corps reserves might be maintained farther forward, fed by road transport. Any dumps in excess of field echelons in advance of corps reserves should be very strictly limited and of a purely temporary nature.

To revert now to the system of movement of stores in advance of railhead. When the trains arrive at their respective railheads, the supplies are taken over by the Railhead Supply Officer (R.Sup.O.), and the ammunition by the Railhead Ordnance Officer (R.O.O.). These officers issue the stores to the Maintenance Companies R.A.S.C. serving the various formations working from those railheads, supplies being loaded in supply section

lorries at S.R.H. and ammunition into ammunition section lorries at A.R.H.

The maintenance companies, when loaded, proceed to refilling points (A.R.P. or S.R.P.) under orders from corps headquarters.

The refilling points are selected normally by the divisions in accordance with tactical requirements from day to day. In consequence it may happen that, when the maintenance companies leave the railheads, the position of refilling points may not be known at corps headquarters. In this case the maintenance companies are sent to rendezvous which are notified to the divisions, where they are met and guided forward to refilling points. On occasions, as when two or more divisions are being maintained on one road, it may be advisable for the refilling points to be selected by corps headquarters; this may also be necessary for purposes of controlling the distance to be covered by maintenance company lorries, and ensuring an even balance of work throughout the various transport echelons.

Having arrived at the refilling points, the maintenance companies unload, and return again to the vicinity of railheads ready for reloading.

At the respective refilling points supplies are taken over by supply companies and ammunition by the ammunition companies R.A.S.C. of formations (second line transport). Their duty is to carry forward to delivery points, that is to unit first line transport. When operations are mobile, delivery points will be constantly changing; in these circumstances it may be necessary to interpolate meeting points, just as rendezvous may have been required for the maintenance companies. Meeting points are fixed by divisional headquarters or by brigade headquarters in accordance with the circumstances, and from these points guides from units lead the vehicles to their own first line transport, where supplies or ammunition are handed over, and the second line transport vehicles then rejoin their own companies.

That constitutes the normal system for the conveyance of the daily needs of the troops in advance of railheads. The tactical nature of the operations in progress, or the necessity for concealment from air observation, may, however, call for modifications in the detailed procedure. Again, the distances that have to be covered will vary considerably from time to time, at one time admitting of cutting out an echelon of the normal supply, at another demanding the interpolation of additional echelons. Or, again, the state of the roads, or a complete lack of them, may call for the use of pack or carrier transport for one or more stages of the journey.

With the increasing measure of mechanization now gradually being applied to our army, it is clear that the problem of petrol supply in the field is assuming considerable dimensions. On an average during mobile operations a division, as now organized, will consume about 14 tons weight of petrol daily. While a force of say, ten divisions or more with its normal allotment of tanks, mechanically drawn artillery, etc., and a corresponding proportion of R.A.F. co-operating with it, will require a provision of petrol on a basis of approximately 100 tons weight daily per division included in the force for all services. At the beginning of a campaign practically the entire supply will have to be in tins; in these circumstances petrol is best dealt with as a normal article of supply through S.R.H. At a later stage, when railway tank wagons and bulk installations in the theatre of war become available, it may be found better to treat petrol more like ammunition: to give it a separate railhead and to allot definite units for its distribution in advance of railhead. Throughout any campaign, however, there will always be about 20 per cent. of our petrol supply required in tins for distribution to individual cars, etc., of headquarters units; this will probably always be handled most conveniently as a normal article of supply.

Another aspect of maintenance which has assumed

great importance in the equipment of modern armies is the question of repairs and maintenance of spare parts. Every unit now has its own artificers, equipped with hand tools, which admit of minor repairs being carried out in the unit; these are first line repairs. Second line repairs are carried out in Ordnance mobile workshops, or in the case of vehicles on the establishment of the R.A.S.C. units they are done by the mobile workshop organization included in the various M.T. companies. Complete overhauls and heavy repairs, called L. of C. repairs, are carried out in the Ordnance Base workshops, and S. and T. Base workshops in the case of R.A.S.C. vehicles.

The R.A.O.C. mobile workshops include in their organization machinery lorries carrying the necessary lathes and repair plant, and store lorries carrying tools and spare parts. They also have one or more *Light Aid Detachments*. These light aid detachments can be sent to any unit requiring help or they can accompany units on the march. They form a link between the unit and their parent workshop. They include in their establishment a light recovery vehicle.

Located, where possible, in the vicinity of the workshops is the *Ordnance Field Park*, a unit intended for the supply of spare parts to workshops and to units, and for the replacement of vehicles in emergency.

A further link in the chain of recovery and repair is provided by the *L. of C. Recovery Sections*. These L. of C. recovery sections are quite distinct from the recovery vehicles which are allotted to all workshops. They are included in the composition of a force to provide a link between the forward area and the L. of C. Their main function is the salvage of vehicles which cannot be dealt with by the formation workshops; they should work from railhead, but may be moved forward in anticipation of an action, if considered desirable. Although these sections are equipped with machinery which can be used to carry out the work of L. of C. workshops in the early stages before the latter are

operating, or to assist formation workshops which are overloaded, this machinery is mostly mounted on trailers, so that the special tractors and breakdown vehicles can be sent out at any time to carry out their main function whilst the machinery trailers are left behind.

An important aspect of the maintenance of M.T. vehicles is the supply of spare parts. For the very large numbers and types of mechanical vehicles now included in our expeditionary force, the requirements in this connection entail the provision of well laid out and well organized base store depots, both for the ordnance directorate for all vehicles except R.A.S.C., and by the S. and T. directorate for vehicles on the establishment of R.A.S.C. units. The requirements for these base installations are, firstly, ample accommodation ; and, secondly, expert personnel for their management ; while, for success in working, intelligible demands from the units to be supplied are essential. This last point may appear obvious, but it is by no means easy of attainment in practice.

To facilitate the problems inherent in the maintenance of M.T. vehicles, two things are required—standardization and training. Standardization reduces the number of types and natures of spares to be maintained ; training reduces the casualties and wear and tear due to bad driving. But with the expansion which our army must undergo for any war of importance these two desiderata are difficult of attainment.

With our existing war establishment a division contains some 500 motor vehicles of sorts, if the motor bicycles are included, while a conservative estimate for a corps of three divisions, with its normal proportion of corps troops, might amount to some 2,700 to 3,000 M.T. vehicles of all types. These figures tend to increase with every advance in mechanization. It is obvious, therefore, that provision of spare parts and the organization for repair has got to be undertaken on no small scale for a modern army in the field. While the

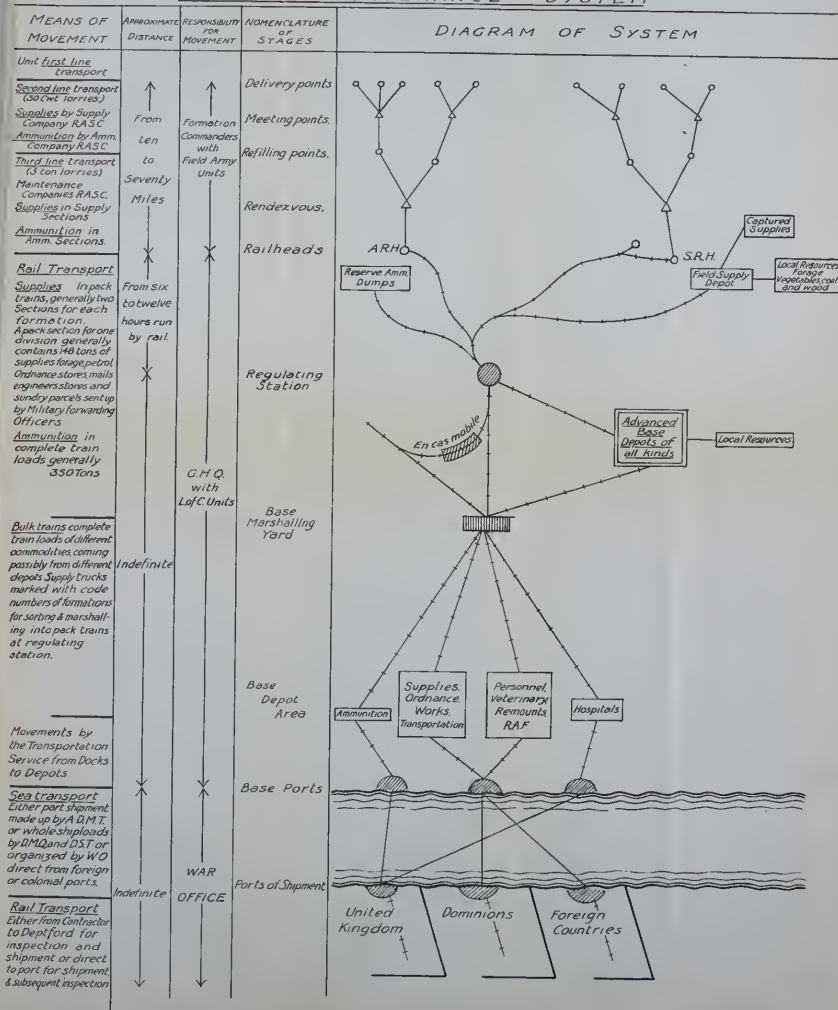
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NORMAL MAINTENANCE SYSTEM

DIAGRAM 8



supply of the enormous numbers of skilled mechanics required is an ever-growing difficulty for the Adjutant-General's Department.

Section 2. The Problem of Munition Supply.

The work of the Ministry of Munitions during the Great War has been fully described in the official history and in a number of other works which have appeared since 1918. The object of this section is to consider how the problem of munitions supply in war affects the soldier and what the soldier's part is in connection with its organization.

When considering munitions, one thinks primarily of shells and guns, but the term has a much wider meaning than that ; it includes war matériel of every nature, ammunition and provisions, and it is in its widest aspect that we must study the question.

A side of the problem, too, which is often overlooked is the restricted nature of the world's supply of certain essential raw materials for munitions manufacture. Examples of this are to be found in shellac, used in making varnish for coating the inside of shells, and jute for making sandbags, both materials which are produced only in India ; at one time cryolite was required for the extraction of aluminium, and it is obtainable only from Greenland. These are examples of geographical restrictions, but cases also occur where the materials we need are also restricted in quantity ; for example, shall we in the future be able to meet our enormous requirements in petrol and oil fuel ? Problems with which we may be faced in war of the nature just indicated should be considered by soldiers in peace time. In the design and specifications of our war equipment, we must remember their effect on the possibility of mass production in time of war.

For all warlike preparations we require a policy. What was our munition policy in 1914 ? Where did it come from ? What is our policy to-day ? And what is the part of the soldier in framing that policy ?

The pre-war policy worked out by the General Staff on instructions from the Government of the day, had been based upon the idea that, in certain eventualities, we should dispatch overseas an expeditionary force of six divisions in all, or in round numbers 150,000 men ; that the Territorial Force should take over the defence of these islands ; and that the Special Reserve should feed the expeditionary force. On this basis, the business of the War Office, in the event of war, was to keep the Army in the field up to strength and to perfect the arrangements for home defence.

Within the narrow limits imposed by this policy everything possible had been achieved. The prescribed supplies, exiguous, almost negligible, as they appear in relation to the vast torrent which subsequently poured across the Channel, were faithfully provided and duly forthcoming to the last detail of equipment.

Based on the policy laid down by the Government the War Office had done its part.

As events proved, our preconceived ideas on the requirements of modern war fell very far short of our actual needs. Not only were we wrong, but the French were equally so, and the Germans also, though possibly to a lesser degree in their case. The surprise of the war was the amount of ammunition that had to be expended. All the belligerent nations were surprised administratively. By the middle of September, 1914, the French were complaining that their 75's fired in days the stocks of ammunition that had been considered sufficient for months. Ludendorff says : "By mid-September the spectre of the shortage of munitions was already apparent." Our own difficulties in this connection are well known. We cannot afford to neglect this question in peace, and, though we may base our ideas on the last war, we must remember that no two wars have ever been alike ; our provision must be capable of meeting our requirements in the next great war.

In the first case, the policy is framed by the Govern-

ment, and it is the taxpayer through his Parliamentary representative who places a limit on that policy. It is the duty of the soldier to estimate the military requirements necessary to give effect to the policy of the Government and to advise on the military necessities of our national situation; but once the policy of the Government is framed the soldiers can only make provision within the money voted by Parliament for the purpose.

The responsibility of the soldier is, however, a heavy one. The size of the army necessary for the purpose must be decided, the scale of its equipment must be laid down, the rate of consumption must be correctly estimated, we must decide on the type, pattern, and design of our essential weapons and stores, and specifications must be completed in every particular.

Prior to August, 1914, this had been done for the small Expeditionary Force then visualized. Yet Lord Kitchener, in 1914, said: "There is no Army." What he meant was, that not only was there no army on the continental scale, but that there was no provision for creating and maintaining such an army. Up till then it had not been our policy to provide one.

As regards our future policy. The end of the last war found us in possession of vast quantities of war matériel of all sorts. Much of this war matériel was, of course, part worn or actually worn out from use; much of it, again, was obsolescent; but after deducting the worn out and obsolete, there was probably enough left to equip an army of the 1918 scale with thoroughly efficient matériel, and something over for further maintenance purposes. At first sight, a very satisfactory state of affairs: we could reduce our army to peace time dimensions while still retaining the munition equipment to expand again to seventy divisions.

But difficulties at once arose. There was no storage space sufficient to hold even a fraction of this vast accumulation; many types of stores rapidly deteriorate if held too long in stock; enormous numbers of men

would be required as caretakers to look after this equipment and prevent deterioration. The very urgent cry for economy made the building of storage accommodation and the provision of caretakers out of the question. So there was nothing for it but to scrap vast quantities of our potential war reserves. Since 1919 further and considerable cuts have been made in army estimates. The soldier, faced with a financial limit to expenditure, has had to decide what was the most vital thing to retain—men or matériel—and still further reductions in our matériel reserves have had to be made in consequence. In all, £681,000,000 worth of war stores have had to be sold since the war was over.

Our present policy—largely dictated by financial considerations—is one of experiment, research and standardization, to find the most suitable weapons. In so far as munitions of war are concerned, we are working up our designs and our specifications; we hope to be able to say, when the next war draws near, what our requirements will be both for immediate supply and for continued maintenance; but we are no longer in a state to send a vast army to take part in a continental war—the munitions supply for such an army would again take months to organize and reach a state of mass production.

One great difficulty has, however, been largely overcome. In 1914, and indeed in 1915 and 1916, it was almost impossible, in the kaleidoscopic changes which were continually taking place, to lay down any satisfactory programme of supply, or to form any reliable estimate of what the armies' requirements might be in six months' time. Now we know, or we hope to know soon, what they would be, whether for a small war or for a war of the first magnitude, and this is a most important step towards its provision.

If you consider the scale of equipment of our army in 1914, with its two machine guns per battalion, its complete lack of heavy artillery, without grenades, gas or tanks, with very limited supplies of signal equipment

and with no H.E. shell for the lighter natures of artillery, and so on—then think what enormous demands in the way of munition supply each new invention called for, and you will see how impossible it was to make any plans for future requirements, which did not become almost useless as fast as they were made.

If we go to war again in the next few years, the soldier can say within reasonable limits of accuracy what his requirements will be for some considerable time ahead—and that is a very great step towards its provision. If you do not know what your requirements are likely to be, it is extremely difficult to make provision to meet them, and sudden extensions of demand can only be satisfied from reserves—that is, from the proceeds of earlier demands.

Reserves, of course, are held in time of peace, but, as already pointed out, financial restrictions necessitate these reserves being very small. The possibility of procuring bulk output at short notice can, in the nature of things, only be satisfied in very exceptional circumstances. The average interval which must elapse between the formation of demand and its satisfaction must be taken in the light of war experience as nearer six than three months. While to organize a new industry and to attain a scale of mass production therein must take at least a year.

To understand why it should be so long we should follow back the course of production from the finished article to its components, and from these to the raw material, with subsidiary programmes concerned with the provision of equipment (machine tools, jigs, etc.), and consider also the transportation and labour problems involved. It will then be seen what a difficult thing the making of a programme of supply becomes, while unpunctuality in delivery at any stage may seriously upset the whole programme, as it often did during the Great War. Again, any changes in specification or design will upset the whole process of production, the preliminary stages of which are both lengthy and

important. Before any new weapon or any radical change in an existing type of weapon, can find itself in the hands of the man who is to use it in action, it must pass through the stages of design, specification, experiment or trial, settlement of scale of issue, manufacture and initial inspection, storage and issue. This is naturally a long process. If, however, the preliminary stages can be completed in peace, it will not take long to reach the state of mass production required for war.

The military machinery for the administration of munitions supply (using "supply" in its broadest sense) is grouped at the War Office under two heads, the Q.M.G. and the M.G.O. : the Q.M.G. being responsible for such items as food, fuel and commissariat stores, accommodation, and the inspection, maintenance and operating of mechanical transport vehicles for the R.A.S.C. ; while the M.G.O. deals with armament, ammunition, equipment, clothing and necessaries, the production of mechanical vehicles, and is responsible for the ordnance factories requiring anything from a reel of cotton to a steam hammer.

The two main sources of supply are the ordnance factories, under the M.G.O., and the trade contractors with whom the Contracts Department of the War Office places the necessary orders.

The demand is formulated by the military department concerned, and either sent to the ordnance factories for completion or passed to the Contract Department to place in the trade ; the whole being subject to financial control by the Treasury. There is a snag in this system from the point of view of the commercial firms, because the military departments are responsible for quality, for accepting deliveries, and for inspection ; the contracts department is only responsible for finding the contractors who are willing to provide what is required and for drawing up and negotiating terms and prices. The manufacturer, accustomed to deal with a single customer, finds himself dealing with an inspection authority and a contracts authority, neither of whom is

competent to treat a bargain as a whole. The difficulties which arose from this cause during the war were many, and they were not finally overcome until May, 1917, when a "Surveyor-General of Supply" was appointed who became a member of the Army Council and whose duties embraced, to quote the War Office memorandum, "all such functions as relate to the commercial side of the business of supplying the army." The Surveyor-General of Supply does not, however, exist in peace.

Our policy in time of peace, in order to provide for war, is to allocate sufficient of the requirements of the Navy, Army and Air Force to the ordnance factories to keep them reasonably in commission, the rest goes out to civil firms.

The war problem, when the contingency arises, involves the adaptation of a peace machine to a more or less unforeseen situation. It is primarily a problem of expansion, for it is quite certain the fighting forces in war will require many things that they have not got in peace, and they will want their requirements met at the greatest possible speed. To provide for their immediate war-time needs each service in time of peace holds its mobilization reserve, one purpose of which is to allow time for the industries of the country to adapt themselves to our war-time needs.

Owing to the heavy capital cost of the stores themselves and the running cost of maintenance and storage, this reserve has of necessity to be kept at the lowest possible limit, and the factor which largely determines this limit is the capacity of industry to produce. Thus, part of the essential reserve of the army is held, not in store, but in the productive capacity of the factories; in consequence, in peace time, we must keep open our lines of communication with the trade, by giving a large proportion of our peace-time orders to civilian firms. Our national insurance for war is, therefore, represented by the ordnance factories at Woolwich, Waltham Abbey and Enfield, and by the armament firms, such as Armstrong and Vickers, and a few other

private firms. In addition, arrangements are made in peace time with certain civilian firms to transfer from peace to war production on the declaration of an emergency, and for the maintenance of certain plant suitable for munitions production.

In a war which engaged little more than the regular army, it is probable that, after the first pressure, industry would adjust itself to the specialized and increased demand, although perhaps on a higher scale of cost than would obtain in peace. In these circumstances peace organization and method can be readily adopted to the new situation.

But a first-class war requires the organization of the whole resources of the nation, and the rapidity and effectiveness with which industry can be organized to meet the emergency cannot but have an enormous influence upon the issue of the struggle. The problems involved are many and varied, and they are dealt with primarily by the Committee of Imperial Defence, though they concern practically every department of State. The chief duty of the soldier in this connection is to prepare the details of his requirements, his specifications and designs, and his estimated rate of consumption in war in any given set of circumstances. To enable suitable preparations to be made, and in order that the organization may work smoothly, it is essential that reasonably accurate estimates should be made of the army's probable requirements for three months, six months, and a year ahead. This is the responsibility of the soldier.

From the foregoing remarks it will be seen that the soldier's task is not the only one in connection with the problems of munitions supply. Industry plays a most important part in fitting out a modern army for war. A great war is a war of organization in which the raising of men is one very important item. It is equally important that they should be equipped, clothed, fed and provided with guns, arms and ammunition, medical and other services. For the provision of these neces-

saries, industry, and industry alone, has to be relied upon. In time of peace there is little difficulty in obtaining what the army requires, the resources of the whole world are at our disposal.

In time of war—a great war—the ordinary resources of the country are insufficient. Manufacturers must be assisted in every way, their difficulties of labour and supply of raw materials must be smoothed, and the most careful organization is necessary to enable the manufacturers to produce to the utmost capacity of their trade. The problems involved are those of man-power and industrial mobilization; these are the statesman's problems; but the problems of strategy are so intimately connected with those of munitions supply that the soldier must study the two together if the strategy, which is his main problem, is to be effective.

Section 3. The Administrative Lessons of the Great War.

The lessons of the Great War in regard to the problems of military movement, and certain lessons arising out of the difficulties of munitions supply have been discussed in previous chapters; the object of this section is to recapitulate the more important administrative lessons in their application to the broad problem of maintenance in its widest sense, and to consider what is the teaching of the Great War in this connection.

We started the Great War with a small expeditionary force of some 120,000 men and 40,000 animals; we ended with a strength, including labour and auxiliary services, of approximately 3,000,000 men and 500,000 animals. In the next great war a similar expansion will be necessary only with this difference, that the development of new methods of warfare and the advance in the mechanization of all arms will call for fresh modifications in our system of administration and for expansion on lines hitherto untried in war.

Although next time there will be many differences in detail in the problems presented for solution, the general nature of the task will be similar to that with

which we were faced between 1914 and 1918. It cannot, therefore, fail to be of value to study how the expansion of our administrative services took place, and to consider what the chief difficulties were and how they were overcome.

The static nature of the operations of the first two years of the war in France caused no undue strain on our administrative services, but with the Somme offensive of 1916 difficulties began to arise. The cumulative effects of the heavy demands made upon the transportation services in rear of the fighting troops were now beginning to tell. The railways required extensive repairs and replacements, for which both men and material were lacking; there was a serious shortage of rolling stock—congestion and delays were occurring in the various docks and base ports serving the armies; the increasing demands made by the armies in the field were throwing a strain upon the lines of communication which they had not been organized to stand. It was now becoming clear that the technical efficiency of every link in a transportation system, working the lines of communication of an army, had assumed an importance far greater than had hitherto been contemplated.

The lesson was being learnt that the problem of the maintenance of an army in the field was primarily one of movement—movement viewed as one whole and continuous process from its commencement, say, in England to the delivery of the goods to the soldier in the front line, and including also the return of the means of conveyance—ship, railway wagon, lorry or limber—to its starting point ready for a fresh load. The realization of this fact is essential for efficiency in any system of transportation brought about the appointment, in November, 1916, of a Director-General of Transportation, whose function it was to control transportation from the ports of landing to the troops, to provide rolling stock and material of all kinds, and to be responsible for railway and road construction.

Concurrently with this realization of the necessity for centralized control of all methods of transportation, there arose also the necessity for administrative control by G.H.Q. of the central reserves of all maintenance requirements of the army, whether food supplies, ammunition, or stores, the organization of which had formerly been the responsibility of the Inspector-General of Communications.

Thus we find one branch of this officer's duties passing to the Q.M.G. at G.H.Q., while his responsibilities in connection with railways and inland water transport had been taken over by the Director-General of Transportation. The appointment of Inspector-General of Communications was therefore abolished, the remaining duties formerly carried out by this officer being given to a newly appointed officer called the G.O.C. Line of Communications.

From the above we get the first big lesson of the war—namely, the necessity for the centralized control of all supply and transport services in the field at G.H.Q. In conformity with this principle, our road transport was entirely reorganized, as already explained in an earlier chapter of this book.

The next big lesson arises out of the munition question, wherein we saw that a modern army is dependent on industry for its maintenance in war, and that the soldier must assist industry by preparing clear specifications of his requirements, with an estimate of the amount of these requirements over various stated periods.

The more we consider these big administrative problems, we come nearer to the conclusion that modern wars of the continental type are no longer won by decisive battles, but by sustained and adequate maintenance arrangements. The army requires its fighting troops, its supply, transport, medical and repair organizations, etc., but behind all this military paraphernalia it requires the entire resources of the Empire, and it requires that these shall be organized to meet the needs of the Empire in arms.

That is the big administrative lesson of the war. What, now, is the solution of the problem ?

Sir William Robertson, writing to the Prime Minister in November, 1915, said : " Victory is assured to us if only we make a reasonable and appropriate use of our superiority in men, money, munitions and ships. We cannot do this unless we have a carefully considered, complete and accepted plan." How should this plan be made ?

A maintenance system such as we now visualize cannot be improvised as a going concern on the outbreak of war. If we leave it till then we shall find ourselves left badly at the starting gate, even more so in future than we sometimes have been in the past. We must work out our maintenance project now in peace. How should we tackle the question ? Just like any other military problem : we must appreciate the situation and write the orders.

If we were called upon to write the necessary orders to set the administrative machine working, we should require first of all *intelligence*—information regarding the resources of our possible enemies and their sources of maintenance and supply ; information, too, regarding our own maintenance requirements, resources and sources of supply. Secondly, we should want a plan. What is our *intention* ? What are we going to do in support of our national Empire policy ? Then would come the *method* of putting the plan into effect, by which we shall organize our resources so as to make them available at the right time and place, so that we can concentrate the maximum force of men and materials at the decisive point.

To consider these three portions of our hypothetical order in greater detail :—

Economic intelligence is our first requirement. Knowledge of the resources of our possible enemies will give us an indication of the force behind any initial blow on their part, and also of their power of resistance to our offensive. We want to know their power of production

of such strategic commodities as coal, iron, rubber, nitrogen, and so on, and the positions of their factories of all warlike stores, whether ammunition, gas or whatever their nature. We must study also their transportation facilities in connection with their munitions supply and the possibilities of war-time development.

Much of this intelligence can perfectly easily be collected in time of peace. Roads, railways and shipping cannot be constructed in secret, and the financial side of big commercial undertakings must be made public to a large degree, which is an indication of the extent of development of commercial resources which are by their nature potential war resources.

Similarly, we must have sufficient intelligence regarding our own economic resources within the Empire ; we must examine our deficiencies in raw material of all kinds and make arrangements to supplement these resources from safe quarters.

We must not start another war, as we did the last, dependent on the enemy for many of our vital necessities. Prior to August, 1914, we got almost our entire supply of optical glass, magnetos, gauges required in gun and shell manufacture, and high speed steel from Germany ; we had not the means of manufacturing phosgene, mustard gas or liquid chlorine, and it was not till after the war that we discovered the secret German system of producing synthetic ammonia and nitric acid from atmospheric nitrogen, which is the basis of the manufacture of our high explosives. Now we can make a hundred tons of ammonia a day, and can expand rapidly to three times that output.

All this mass of economic intelligence must be collected and collated and kept up-to-date ; it must be continually examined by the soldier, sailor and airman to ensure that our war-time resources are adequately protected, and that we know how best to attack those of our possible future enemies. It is easy to be wise after the event ; we were not wise before the event of 1914 ; shall we be wise before that of 19— ?

War is no longer the affair of the Admiralty, War Office and Air Ministry alone—practically every Government department has an essential part to play. On the Committee of Imperial Defence now falls the task, under Cabinet direction, of co-ordinating the efforts of the various departments of state for the collection of the necessary intelligence to be placed at the disposal of the fighting services.

So much for intelligence. We have dealt with the “information” paragraph of our War Order; we can now pass on to the “intention” paragraph.

The intention we want is that of our Government; what are we as a nation going to do in certain eventualities?

Our intention prior to August, 1914, was to send six divisions to a continental war; what do we mean to do next time? Apart from wars outside Europe which we may be engaged in, in furtherance of our world-wide interests, we now have the Locarno Pact which gives us definite responsibilities as regards continental troubles. Based on this pact the part to be played by Great Britain in certain eventualities will presumably be determined by our Government. The Government policy is the intention paragraph of our War Order. It is scarcely conceivable that we shall be engaged in a great European conflict without the active support of the Dominions, though, of course, they have complete freedom of action in this respect, but our administrative arrangements will naturally include drawing on the resources of the whole Empire in furtherance of our military policy, and the attitude of the Dominions is a very important factor in framing that policy.

The part of the soldier in the preparation of this intention paragraph will be limited to the making of an appreciation of the situation which will be the military advice upon which the Cabinet will base their plan.

Now for the method of putting the plan into effect. In so far as our peace-time preparations for war are concerned this involves three big undertakings:—

- (a) Our military (including Naval and Air Force) mobilization plans ;
- (b) Our national mobilization ;
- (c) Our industrial mobilization scheme.

As regards the first of these, our military mobilization plans are, of course, worked out in time of peace. Our arrangements in 1914 worked very well, but next time it is going to be a bigger and more difficult undertaking. Unit and formation mobilization schemes call for constant examination, revision and trial. In spite of a general success in 1914, there were many little hitches and difficulties which might have been avoided ; in our present scheme there are many items that have not yet been practically tested. Successful as we were in 1914, there were many degrees of success as between units, formations and areas. Mobilization is a subject of great interest which concerns every officer and the perfecting of our arrangements in peace time will, when war comes, amply repay any amount of trouble taken beforehand.

The German Air Force in 1914 could not interfere with our mobilization arrangements. But to-day the situation is different. Our mobilization store depots, our embarkation ports, our troop concentration areas, our railway systems, are well within reach of the air forces of our continental neighbours. We must remember this in working out our mobilization scheme, and take adequate steps to deal with this possible form of interference with our plans.

As regards the interference that may be expected from air attack we have only war experience and conjecture to guide us. Sixty attacks were made by the Germans during the war on Woolwich Arsenal. Only one was successful. On October 13th, 1915, six bombs fell in the Arsenal ; one man was killed, four injured, and two machines wrecked. But although the material results were so meagre, the actual loss of working time from air raids or warnings of air raids, and the precautions which had to be taken in consequence was a very serious

matter. What the effect may be in the next war we can only surmise.

We will pass on now to the next sub-paragraph of our method—national mobilization. Just as we soldiers have mobilization schemes, and likewise the Navy and Air Force, so also the various Government departments such as the Board of Trade, the Home Office, the Ministry of Labour, etc., all are preparing their schemes, and next time we may expect to see our Ministry of Shipping and Ministry of Munitions coming into existence on the outbreak of war with as much ease as our new divisions and so on are formed on expansion from our peace-time military organization.

In 1914 we had practically no scheme for national mobilization on these lines, but the big administrative lesson of the war has been taken to heart by our statesmen, and though our plans may not yet be perfect, we are now certainly in a far better position in this respect than we have ever been in the past. Owing to peace-time financial stringency there is little doubt we shall go to war next time deficient of much that we require, but we may rest assured that the situation will be infinitely better than it was in 1914.

The last sub-paragraph of our "Method" paragraph is industrial mobilization. This, perhaps, is the biggest problem of the lot, but the lesson of the Great War clearly points to the necessity for something of the sort. To make really effective arrangements to this end requires legislation, which is outside the province of the soldier; but it is the soldier's duty as a citizen to educate his civilian brothers in this vital question of empire defence.

The French Government has passed a law for the organization of the nation in time of war. This measure forms part of the whole scheme of national defence, and provides for the organization of services and essential supplies during war time. It contemplates in advance the setting up on a definite plan of all the varied machinery for supplies, for transport for mobiliz-

ing or requisitioning of persons, businesses, and works which are required in war. We need something of a similar nature for our own country.

One does not visualize this country entering on a war of any magnitude without the wholehearted support of the great mass of the people ; but next time we go to war we must not let our national enthusiasm run riot. Our potential officers, our skilled mechanics, our expert chemists, our miners and metal workers and skilled artisans must by some means or other have their particular knowledge or mechanical skill directed into the best channel in which to help the nation in arms. Our available man power and woman power must be mobilized from the outset.

Next we must mobilize our manufacturing plant and organize its adaptation and expansion to meet war requirements. Similarly, we must mobilize the Empire sources of raw material to ensure that all that is needed is directed to the Empire's machine shops for conversion into our essential war equipment. The big national scheme for the provision of power is a very useful step in our industrial mobilization for the next war.

Our chemical industry will need very considerable expansion to deal with the possible requirements of gas warfare.

Our staying power as a nation in arms depends very largely on how far military demands and civil supply can be harmonized. It is clear, of course, that much of this work is outside the province of the soldier ; but the soldier cannot afford to neglect this aspect of war preparation entirely.

In making our own detailed military plans for mobilization and the necessary war expansion of our armed forces, we must have continually in view the big main problem of the nation in arms ; we must not work in water-tight compartments, but build up our army with due regard to the requirements of the other departments of state.

To complete the analogy of the war order, of which

the first three paragraphs have now been considered, two more headings require to be dealt with—namely, administrative arrangements and inter-communication.

Administrative instructions will be very detailed and will deal with each of the sixteen main services which are required for the maintenance of a force in the field.

The contents of these instructions will be largely technical, and the detailed requirements are being closely examined at the present time, but there is still much co-ordination work to be done. In the technical aspects of peace-time preparation the services are very severely handicapped by the financial problem. The increasing unwillingness of the nation as a whole, as their memories of the Great War recede farther into the background, to pay the necessary insurance premium towards minimizing the effects of the next war on posterity, cramps the style of the military technical expert. Research and experiment are, however, being carried on, though we could usefully do much more in this direction were funds available. With the war lesson of military dependence on civil organization staring us in the face, we must direct our energies towards stimulating the development of civil firms to produce in peace for commercial use what is readily convertible to our war-time needs. We have at the present time various committees examining into these problems, such as :—

- The Royal Artillery Committee ;
- The Royal Engineer Board ;
- The Chemical Defence Committee ;
- The Wireless Telegraphy Board ;
- The Ordnance Committee ;
- The Mechanical Warfare Board ;
- The Clothing and Equipment Committee ;
- The Army Hygiene Advisory Committee ;

and several others.

And a number of experimental establishments and research departments, all within the limits of the funds at their disposal are busy filling in the gaps of the administrative instructions in our War Order.

The co-ordination of the work of these many committees and establishments, the interchange of ideas between the Navy, Army and Air Force, the liaison between the fighting services and civil firms in all matters concerning the equipment of our future military forces, are questions of the highest importance, not only for the Committee of Imperial Defence, but for all who aspire to high command in war. We must ensure that the work of research and experiment for the fighting services is so co-ordinated in peace as to obtain the best value for money and the highest output in time of national emergency.

Now for the last paragraph of the War Order—*Inter-communication*. On the successful working of our arrangements in this connection everything else depends. It is not proposed to deal with it here, the problem is an operational rather than an administrative one; the Navy, Army and Air Force are all concerned. We must keep open our communication with our sources of supply of raw materials—oil, nitre, wool, cotton, food supplies, etc., are all vital to the maintenance of our fighting forces, and we cannot get them without safe communications. This is so obvious that the subject need not be enlarged on, except to point out that in safeguarding our tactical communications with the various portions of our far-scattered armies, we must be careful not to neglect our strategical communications which are often purely administrative in their nature; some of our essential war materials are only found in very few places in the world.

One more point—when we take part again in another European war, we shall probably have allies on our side. The value of unity of command was proved in the last war, so was also the value of unity in control of administrative matters. We never reached a very satisfactory state in this connection; though the principle of pooling all allied resources was accepted by all, it tended in practice to sharing the resources of the British Empire without very much in the way of

payment. Until, however, some arrangements had been made to this end, the competition of the allied Governments in purchasing in the neutral markets resulted in serious waste and soaring prices.

The United States of America grew rich as long as Europe had any money to spend, and then she entered the war, and prices fell.

We do not yet know who our allies will be in the next war, so we cannot very well make pooling arrangements in peace. Some arrangement of the kind will, however, need to be set on foot at the very beginning of the next war in the interest of economy and efficiency.

A few of the chief administrative lessons of the Great War have now been considered; some others will be dealt with under the heading of War Exhaustion in a later chapter. Some of these lessons are for the statesman rather than for the soldier, but sufficient has been said to show how closely related are the tasks of each. It is a duty incumbent on the soldier to advise the statesman, and to educate the people, in the broad principles of military administration and in their application to the nation's war-time needs.

CHAPTER VI

TACTICAL ADMINISTRATION.

Section 1. Administration in the Attack.

IN previous chapters the broad principles governing movement and maintenance have been dealt with primarily in their strategical aspects, and in their application to the lines of communication of an army in the field. In the present chapter the tactical aspect of military administration will be considered in its application to the troops in contact with the enemy, and when engaged in battle.

We will take first the question of administrative preparations for an attack. These can best be considered in four stages :—

- (a) Reconnaissance ;
- (b) The formation of the administrative plan ;
- (c) The detailed preparation prior to the attack ;
- (d) The maintenance of administrative services during and subsequent to the actual attack.

As regards the first of these, reconnaissance is every bit as essential in the case of administrative preparations as it is for tactical purposes ; with this difference only, that the administrative reconnaissance must cover much more ground. The administrative officer requires to see not only the ground on the front of attack and as much of the ground in the possession of the enemy, over which the attack is to go, as the tactical situation admits, but he must also reconnoitre the back areas behind the actual front of attack over which the administrative services will be functioning.

This reconnaissance can conveniently be divided into two parts : a general reconnaissance of the whole area by the senior administrative officer concerned ; and a

detailed reconnaissance for special purposes made by subordinate officers under the direction of their immediate chief. Thus, if we take the case of a division for purposes of example, the A.A. & Q.M.G. would carry out the general reconnaissance of the whole area from the front held by our troops back to a depth of, say, ten thousand yards, and he would include a study of as much of the ground in possession of the enemy as it was possible to see from one or two selected observation posts. In this reconnaissance the A.A. & Q.M.G. would note particularly the general condition of the roads, and their suitability for use by horsed and mechanical transport, their width, surface, gradients and to what extent they were screened from observation by the enemy from the ground and from the air. He would note the nature and type of villages and buildings, and form an opinion as to the accommodation possibilities of them. He would look for suitable parking places for mechanical transport, general areas suitable for wagon lines and transport of all kinds, bearing always in mind the question of cover from air observation.

The water supply of the area for man and beast would command his particular attention, suitable sites for water points, the use of which would not impede traffic, might be selected. Localities for dumping ammunition, supplies, engineer stores and water would be looked for, both with reference to the attack in question, and also with regard to a subsequent advance.

Traffic control problems would also need consideration with special regard to dealing with civilian population and refugees should this question arise.

Medical and veterinary arrangements would likewise be considered, as the A.A. & Q.M.G. must be in a position to decide in the best interests of everyone, between the possibly conflicting requirements of all the services represented in the division.

The very extent of this reconnaissance in conjunction with the time factor precludes the possibility of detailed work at this stage, but for efficient co-ordination it is

essential for the A.A. & Q.M.G. to have this picture of the whole area clear in his own mind.

For the details he can use his D.A.Q.M.G. and D.A.A.G., to investigate and settle what is necessary, to locate exactly the sites for dumps for various administrative requirements, to do the detailed allotment of available accommodation, etc., in conjunction with the units or individuals primarily concerned.

The method of making these reconnaissances is exactly the same as in any other form of reconnaissance. First of all, be quite clear in your own mind what you want to see, and from a study of the map know where you expect to find it, and then go and look for it.

This reconnaissance can never be dispensed with, even when relieving other formations already in occupation of an area; different people's views of the same thing vary enormously. Between "handing over" and "taking over" there is a great gulf fixed; you must go and see for yourself.

The reconnaissance made, we can get on with the formation of the administrative plan.

The administrative plan is not a separate thing in itself, it is a definite part of the commander's plan, built up as the result of the reconnaissance and so as to fit in with the tactical requirements of the situation. Based on the reconnaissance the framework is constructed upon which the main services—ammunition, supplies, medical, engineer, etc.—will work. As the tactical plan develops in detail so will the administrative plan, as particular requirements are disclosed; when ready the whole is included in the form of administrative instructions issued in conjunction with the operation order on which they are based. This plan, as contained in the administrative instructions, must provide for:—

- (i) Producing all the material necessities required for the battle, such as food, water, ammunition, petrol, medical stores, etc., etc., and distributing them to the places where they are wanted.

- (ii) Maintaining the supply of these various commodities throughout the battle and when the advance continues as the result of the success of the attack.

Administrative instructions will vary in accordance with the nature of the operation in progress, and according to the formation by which they are issued. In some cases, a short paragraph included in the operation order will suffice, in others elaborate instructions may have to be issued separately from the operation order.

The various items that *may* require consideration in framing administrative instructions for operations are summarized in Appendix 5. This is a comprehensive list, many items in which would not be required in any given set of circumstances; each case must be dealt with on its merits and in accordance with the tactical conditions of the particular operation.

It is well to remember, however, that any attack, other than a purely encounter battle, is almost certain to require more ammunition than is carried in the field echelons immediately at disposal. In consequence, arrangements for providing the extra quantities required must be set on foot at the earliest moment. The limitations imposed by roads, distance and carrying capacity of available transport in connection with ammunition supply, may well be the determining factor in the timing of the attack.

Again taking the case of a division in an attack, for purposes of illustration, the administrative orders will normally require that the following items should be dealt with :—

1. Ammunition for artillery and S.A.A. : Amounts to be dumped, and transport arrangements.
2. Supplies, including water : meeting points, or advanced rendezvous.
3. Baggage and greatcoats : distribution or disposal.

4. Engineer stores for the attack and for consolidation : means of transport.
5. Medical arrangements : position of dressing stations.
6. Veterinary arrangements : position of mobile veterinary section.
7. Ordnance services : position of mobile workshops, and light aid detachments.
8. Provost services : stragglers, posts and prisoners of war.
9. Civilians : disposal of refugees.

If it is found necessary to elaborate any of these subjects beyond a few words, then the situation certainly calls for the issue of administrative instructions, separate from the operation orders which should never be encumbered with a mass of administrative detail.

The more mobile the operations the less, speaking generally, are the administrative requirements. When more static conditions, involving elaborately prepared attacks occur, the essential administrative preparations tend to become very extensive. They may then include the formation of large dumps of the various commodities required, such as ammunition of all kinds, supplies, engineer stores, water, camouflage material, provision of extra accommodation, etc., etc.

In this connection the necessity for secrecy will demand most careful consideration. The growing size of dumps, an increase of transport moving in an area, the provision of additional hospital accommodation, or increased activity generally in back areas, will afford valuable information to the enemy of the intention of a commander. This calls for the careful concealment and camouflage of all new dumps or work, and may necessitate all movement of troops and transport being confined to the hours of darkness. It is easy enough to say this, but it adds a considerable complication to administrative preparation ; it takes more time and requires very careful and detailed staff work to avoid mistakes and loss of time which may be very serious.

In this detailed preparation work the task of the staff is first of all to arrange a programme of work ; this programme should show clearly :—

- (i) The work to be done in order of priority.
- (ii) Who is responsible for the work, and what labour is available for doing it.
- (iii) Special precautions for secrecy and arrangements for camouflage where necessary ; instructions as to working by daylight or at night.
- (iv) Dates when work is to begin and by when it must be finished.

When any considerable dumping of ammunition or stores is required, careful calculations have to be made and additional transport has to be arranged for. In such cases the programmes of work should show the transport allotted and the sources from which it is to be provided.

In war you are always working against time, and even if plans are made well in advance, it is generally inadvisable for reasons of secrecy to make any obvious preparations until the latest possible moment. This applies particularly to such things as erecting extra hospital accommodation, putting up sign-boards and notices, collecting large dumps of reserve stores, and so on. All this necessitates much thought, calculation and co-ordination by the staff to ensure the smooth working of all the services in co-operation when the word " go " is given.

As shown above, the administrative plan when formed is given effect to by means of the administrative instructions. But there are certain items which must be considered when making the plan which will not be included in the orders, these orders being confined to the actual operations in contemplation. The responsible administrative officer must, however, always be prepared for sudden changes which may occur. Such changes may be brought about by an alteration in

direction, a re-allotment of boundaries, other formations coming in on a flank and requiring road facilities formerly at his disposal, and, finally, by the possibility of failure and subsequent withdrawal. Arrangements to deal with such cases will not appear in orders, but they must be foreseen and thought out in advance.

The administrative plan having been formed and the detailed arrangements completed, the battle is the proof of the pudding. It will show whether the administrative plan was sound and the administrative preparations complete.

If congestion of traffic occurs ; if stragglers are not collected and dealt with ; if ammunition, food or water do not materialize when and where required ; if barbed wire and tools are not forthcoming when wanted ; then there has to some extent been administrative failure. This may result in tactical or strategical failure. The tactical or strategical plan must be administratively sound in the first instance, and the detailed administrative arrangements must also be complete, or sooner or later failure will result. A few instances from the Great War may be quoted in support of this contention :—

- (1) Generals Rennenkampf and Samsonoff attempted to advance into East Prussia in 1914 without waiting for their administrative arrangements to be completed ; the starvation which resulted contributed materially to their defeat, and caused misery and suffering to their troops.
- (2) General Townshend's force in Mesopotamia outran the possibilities of maintenance ; largely from this cause it was compelled to surrender at Kut.
- (3) The Turks were defeated at the Battle of Rumani, but pursuit was brought to a standstill by lack of water, and the Turks escaped.
- (4) The German 22nd Corps failed to arrive in time on the battlefield of Gumbinnen, because

traffic control had been neglected and the roads were blocked with refugees. The result of this was a strategical success for the Russians.

- (5) Two divisions of cavalry failed to join von Francois at the Battle of the Masurian Lakes, because the roads through the Lotzen Gap were blocked by the administrative services of the 27th Corps. In consequence the German attack failed.

In battle unforeseen situations almost invariably do arise; a commander holds a reserve partly to deal with such eventualities. In the case of administrative requirements, the reserve which is most generally needed is one of transport, and the responsible administrative officer will be well advised to keep such a reserve in hand; it is the solution of most difficulties which are likely to occur. The location and probable employment of this reserve will be indicated by reconnaissance in the first instance, and later by close administrative liaison with formations and units throughout the progress of an operation.

A reserve of this nature is particularly necessary for the satisfactory maintenance of administrative services during the pursuit which we hope will follow our successful attack. It is of the highest importance that, in their pursuit, the troops should not be hampered in any way by a shortage of ammunition, supplies or water, nor their movements be encumbered by wounded or prisoners-of-war. This calls for careful arrangements prior to the attack. As soon as the advance begins, ammunition, water, engineer stores and supplies should be got moving, too, on a pre-arranged and organized plan, fully co-ordinated with troop movements. Our armoured fighting vehicles must not be brought to a standstill for lack of petrol, or our guns silenced for lack of ammunition, or the men themselves exhausted for lack of water; these essential needs must be sent forward, but in getting them up we must not block the

roads required for our reserve troops, as in the case of von Francois' cavalry at the Masurian Lakes in the example quoted above.

The successful maintenance of the pursuit, until such time as the enemy is driven from the field, depends very largely on administration; but in this there must be the closest possible co-operation with tactical requirements.

Tactical and administrative considerations are complementary to one another—there must be no watertight compartments. With due regard to the requirements of secrecy, all concerned in administrative arrangements must be kept fully informed of the situation. A few moments' thought will show the importance of this point.

The dumping of ammunition takes much time and thought; this may well affect the hour at which an attack can be launched.

The correct timing of the movements of transport, combined with efficient traffic control, will prevent troop movements being interfered with, as happened at the Battle of Loos.

Medical arrangements take time to make; if unusually heavy demands are likely to be made on the Medical Service, the responsible officer must be informed in sufficient time to enable the necessary organization to be prepared; this was not done at first in Gallipoli nor in Mesopotamia.

The tactical action of artillery may destroy roads required for transport at a later stage, thus calling for special organization for the provision of engineer stores and road-making material. The Ypres salient is an example of this.

Requirements as regards accommodation, rest and comfort of the troops prior to an attack must be balanced against the demands of secrecy. The strategical concentration prior to the first Battle of Cambrai illustrates this point. On the other hand, administrative preparations which may be observed from the air, or

reported by agents, can be used to mislead the enemy, and thus assist in obtaining surprise.

Our administrative arrangements should aim at establishing a feeling of confidence amongst the troops that their administrative needs will always be met, in spite of apparently the most adverse conditions in the front line. The amount of actual preparation possible, prior to an attack, will of course depend upon the time available. But the smooth working of supply and evacuation services will depend very largely on the skilful organization of the area by the administrative staff. The correct location of administrative units with regard to existing communications, cover and water, and adequate provision for the organization of traffic, are matters of the highest importance; but most important of all is the training of administrative units and services themselves to ensure the automatic working of maintenance services even in default of orders from higher authority.

APPENDIX 5

PRINCIPAL MATTERS WHICH MAY HAVE TO BE DEALT WITH IN ADMINISTRATIVE INSTRUCTIONS ISSUED WITH AN OPERATION ORDER.

1. Accommodation.

- (a) Administrative areas.
- (b) Accommodation immediately before, during and after an operation.
- (c) Details of any special accommodation allotted or to be constructed.

2. Ammunition.

- (a) Ammunition railheads.
- (b) Ammunition refilling points.
- (c) Location of dumps, or reserves on wheels, and quantities to be dumped and formation to which allotted.

- (d) Responsibility for working dumps and labour to be provided.
- (e) Special instructions regarding S.A.A. grenades and fireworks.
- (f) Special arrangements for advance or withdrawal.
- (g) Accountancy instructions, and times when expenditure returns are required.

Note.—If an allotment of rounds per gun is made or a limit set to daily expenditure, instructions for this are issued by G. after consultation with Q.

3. Supplies.

- (a) Supply railhead
- (b) Supply rendezvous
- (c) Supply refilling points.
- (d) Supply meeting points.
- (e) Outline of system of supply where departure from the normal is necessary.
- (f) Any special issues—rum, solidified alcohol, etc.
- (g) Details of attached units, responsibility for supply, and dates to and from.
- (h) Dumps of reserve supplies, location, quantities, and responsibility of formations.
- (i) Special arrangements for advance or withdrawal.
- (j) Any special arrangements for petrol.

4. Water Supply.

- (a) List of approved sources for drinking, watering animals and washing.
- (b) Allotment of sources between units, time-tables and instructions.
- (c) Responsibility for provision of pumps and troughs.
- (d) Special allotment of water tank vehicles, reserve water carts, petrol tins or other receptacles.
- (e) Intelligence regarding water in enemy territory.
- (f) Orders for special water reconnaissance, testing and marking of sources of supply.

5. Transport.

- (a) Any special allotment of transport for use outside its normal work.
- (b) Light railways and tramways; allotment; means of obtaining facilities; special instructions.
- (c) Mechanical transport; allotment; position of breakdown gangs, workshops, tyre presses and special parking places.
- (d) Horse transport special allotment; division of unit transport into echelons and control of echelons; organization of special pack transport.
- (e) Special transportation facilities, barges, ambulance trains.

6. Engineer Services.

- (a) Method of supply of stores and material.
- (b) Position and responsibility for formation of dumps of R.E. stores and tools.
- (c) Special issue of stores, tools and transport allotted.
- (d) Tramway extension material.
- (e) Camouflage material.
- (f) Provision and erection of sign-boards.
- (g) Detail of any special water parties.

7. Medical Services.

- (a) Positions of C.C.S., M.D.S. and A.D.S.; any special instructions for R.A.F.
- (b) Position of Collecting Posts and Car Posts.
- (c) Detail of personnel for Walking Wounded Collecting Station.
- (d) Allotment of transport for W.W.C.P.
- (e) Additional stretchers, blankets and bearer parties.
- (f) Provision of soup kitchens.
- (g) Temporary re-allotment of field ambulances and forecast of moves.
- (h) Any special sanitary precautions.

8. Veterinary Services.

- (a) Position of V.E.S. and M.V.S. and arrangements for evacuations.
- (b) Position of Advanced Animal Casualty Collecting Posts and personnel for manning.
- (c) Disposal of captured animals.

9. Ordnance Services.

- (a) Position of ordnance store if formed.
- (b) Issue of any special stores.
- (c) Position of light aid detachments and mobile workshops.
- (d) Position of L. of C. Recovery Sections.
- (e) Position of salvage dumps, transport and personnel allotted.
- (f) Movement of railhead detachments.

10. Provost Services.

- (a) Traffic control posts, position and personnel.
- (b) Issue of traffic circuit maps, M.T. and H.T.
- (c) Restrictions as to movement in daylight.
- (d) Restrictions as to use of headlights at night.
- (e) Special traffic arrangements in an advance or withdrawal.
- (f) Stragglers' posts; personnel for manning; method of return of stragglers to units.
- (g) Prisoners-of-war; position of cages; provision of guards and escorts; routes to be followed; responsibility for collection and evacuation. (Interrogation in conjunction with G.S.)
- (h) Sign boards.

11. Casualties and Reserve Personnel.

- (a) Time and method of reporting casualties.
- (b) Reinforcement reception camp; location and personnel for control.
- (c) Detail of unit personnel to be left out of battle; where to go; sanction required for sending up.

Section 2. Administration in Defence and Retirements.

(A) Defence.

Much that has been written in the previous section on administration in the attack applies also in the case of defence. As in the case of the attack, so in that of the defence we first of all require reconnaissance, though possibly to even greater depth and wider to the flanks. Secondly, we require a plan, though this plan must usually visualise larger reserves of administrative necessities. Thirdly, we require detailed arrangements for the counter-attack, for resuming the offensive, and, finally, for the possibility of withdrawal.

A defensive attitude implies lack of movement for the time being, at any rate. This entails increased knowledge by the enemy of our rearward organization, and increased use and accuracy of his harassing tactics by land and air. In consequence, modifications will tend to be imposed on our administrative arrangements in direct proportion to the length of the stationary period. Our railheads, dumps, hospitals, etc., may be forced farther back from the front, or they may require a greater measure of protection in one form or another. Similarly, our communications become more liable to attack by air and long-range artillery fire, and more elaborate arrangements are called for to meet the possibility of interruption from these causes.

The longer we adopt a defensive attitude the greater and more elaborate becomes our administrative organization. We require more complete arrangements for the A.A. defence of our railhead areas and our communications in front of them. We must provide alternative means of forward communications by light railways, tramways, and cross-country tracks for horse transport. We must improve and add to our road facilities for mechanical transport. We must provide reserves in advance of all bottle-necks, such as bridges and narrow defiles, liable to be blocked by the action of the enemy, or construct avoiding routes round all such bottle-necks ;

and roads which are under observation by the enemy must be screened from his view.

Difficulties which are likely to arise from the vulnerability of our communications can generally be overcome by judicious dumping of essential commodities in advance of localities where interruption is most likely to occur. Such dumping should usually only be necessary in the case of ammunition, engineer stores, water, road material, and stores of a bulky nature for which transport is not normally provided, or is insufficient to meet the demands of static operations. Each case must be considered on its merits, as it is equally bad administration to dump what is not required as to fail to dump what will probably be needed.

The next point for consideration in connection with defensive administrative arrangements is that our attitude of the moment is only a preliminary to the resumption at the right time of the offensive. Our administrative plans must be such that they admit of this change to the offensive taking place without difficulty or delay; that is, a definite plan for all maintenance services when the advance begins must form part of our arrangements while still on the defensive. Furthermore, all defensive plans contain arrangements for the counter-attack in the event of the enemy penetrating any part of our defensive system; our administrative organization should be prepared for such an eventuality. The force of our counter-attack must not be lessened by any lack of maintenance requirements, nor must our general system of maintenance be interrupted by any partial penetration of our front by the enemy. That is, we require administrative reserves and alternative means of supplying the various needs of the troops.

Finally, we must ensure that our defence shall not at any time be prejudiced by a lack of material resources; these resources must be maintained without interfering with the mobility of the fighting troops. The most difficult time of all to ensure this maintenance is during

a retirement, and our administrative organization, when on the defensive must include the arrangements necessary to meet the situation arising out of a possible retreat.

The supply of a force (using the word "supply" in its widest sense), when on the defensive, and its continued maintenance when the advance is resumed, a counter-attack launched, or a further withdrawal takes place, depends very largely upon the correct location of the units forming part of our system of supply, and evacuation with regard to the available communications and the special factors affecting their use. The whole area in rear of the troops who are in contact with the enemy needs to be organized with due regard to possible tactical requirements, the maintenance of supply, and the mobility of the troops.

Reconnaissance for administrative purposes is essential to ensure that our maintenance organization can be adjusted to the actual situation, and it must be carried out in considerable depth and wide to the flanks. Time will always be the deciding factor in the amount of reconnaissance possible, and for this reason there must be the closest co-operation between the various branches of the staff for the interchange of information which it is essential for all to know.

Depth is always essential both in attack and defence ; if anything, our administrative organization requires more depth in the defence than in the attack, but this organization must also be carried out well to the flanks of the actual area of operations.

We must be able to expand and to contract, and if necessary to change front ; it must be possible to side-slip, or to bring in other troops on the flanks without upsetting our maintenance arrangements ; and in the event of our forces being driven off their main rearward lines of communication, maintenance must be provided for by alternative flank routes. At the same time, our administrative organization in rear must not disclose the lines upon which it is ultimately intended to resume the offensive.

Staff officers must always think large and reconnoitre wide to the flanks when making defensive administrative arrangements ; they must never be parochial, but must always keep in mind the big picture of the whole administrative machine right back to the base. Mistakes will occur in the detailed administration of units, and of the lower formations, unless those concerned can get this clear mental picture of the whole administrative machine.

In our peace training the administrative units of war are largely non-existent, and it may be argued that it is difficult to form the correct mental picture of what is never seen in the flesh. In war, when the troops are actually there, and the trains, columns and convoys are really in motion on the roads, the picture will still be only a mental one, as the area covered is so large and no one can be everywhere at once. Yet we must aim at visualising the whole picture, including the units and formations on our flanks, and those of higher formations, rearward services, and of the lines of communication. In so far as the officers concerned are unable to do this will their efforts be disconnected and conflicting, resulting in delays, congestion and consequently loss of efficiency.

The secret of success lies in the maintenance of reserves. No one would think of fighting a battle without tactical reserves, but administrative reserves are also essential and are very apt to be forgotten. Reserves of ammunition, of transport, of tools, of engineer stores, of water, cable, medical stores, and ordnance stores are all required, and they all demand road space, which is often difficult to come by. In our peace training we never have them ; in war there is danger of our forgetting them until it is too late.

(B) Retirements.

Withdrawals are undoubtedly the most difficult operations of war ; they are particularly so from an administrative point of view. The chief difficulty of

administration during a retirement is in accurately organizing and timing the movements of administrative units so that, though the fighting troops may lack nothing essential to resistance, their freedom of movement shall not be hampered.

In a division, as at present organized, we have to deal with both horsedrawn and mechanical transport. The administrative units of a division, together with the administrative portion of the fighting units which can be temporarily separated from them, occupy in column of route approximately eight miles of road space; while a corps of three divisions with a normal proportion of non-divisional units, would have nearly forty miles of mechanical transport to dispose of. It is clear from these facts that, should the tactical situation necessitate a hasty withdrawal, and the number of roads available be limited, the problem of clearing the roads, while still maintaining essential administrative services, is by no means an easy one.

The plan must be ready in advance. The best chance of success lies in a time-table carefully prepared beforehand, drawn up in the form of a march table, and requiring only the addition of the zero hour to put the whole in motion.

The responsible officers must be quite clear in their own minds how the services of supply, ammunition supply and medical evacuations are to be conducted throughout the withdrawal, bearing in mind that unit first-line transport is only capable of carrying the current day's issue of supplies, or its war equipment load.

A first essential for success in the maintenance of fighting necessities, such as ammunition, food, water and tools, is a good system of communication between the various echelons of transport in which these requirements are carried. By this is not meant telephone communication or wireless, for such means are not likely to be available in mobile operations for detailed administrative purposes; what is meant is a well-organized system of personal liaison by the officers

concerned, and an efficient chain of communication by orderly between the units supplying the various commodities and those to whom they deliver the goods. This calls for initiative on the part of staff officers and commanders of all administrative units, including officers detailed to command such temporary groupings as infantry brigade ammunition reserves, or brigaded "B" echelon of first-line transport. It also calls for training of individual non-commissioned officers and men who are to act as the orderlies moving between the various echelons ; this is a form of training which is frequently overlooked.

Hitches and delays are most likely to occur after a period of stationary warfare, when supply services have been going on as a matter of daily routine between the same places and over the same routes for some time. A sudden change of routine brought about by a retirement is likely to find the essential communications non-existent ; it is the duty of the administrative staff to ensure that it is properly established.

For smooth working a clear definition is required, preferably in operation orders, of the responsibility for ordering the necessary moves of the various transport echelons, maintenance companies, supply, baggage and ammunition companies, mobile workshops, ambulance convoys, brigaded unit transport, etc. The degree of centralization of control will depend to some extent on the frontages occupied by formations, on the number of roads available, and on the efficiency of the existing communications. But the pace of movement of mechanized transport, and the enormous amount of it found now in rear of our fighting formations, calls for a high degree of centralization of control of its movement if confusion and consequent delay are to be avoided.

A well thought out time-table is the basis of a well-organized withdrawal. It is too late for a staff officer to begin planning his move in a retirement after the necessity for it has arisen. Reconnaissance, liaison and preparation for all eventualities must be continuous in

all matters of administration. The responsible officer must always know where the units are, what is their situation as regards supply, ammunition, tools and stores of all kinds. For this he must not rely on telephones, telegraph or wireless, or in the event of a sudden successful attack by the enemy he will certainly lose touch. Once touch is lost, the commander can no longer control the situation, and if control is lost there is risk of demoralization occurring.

The general principles governing administration in defence and retirements have been outlined above; we will now examine their application to particular services in rather more detail.

In the defence the problems of the administrative officer divide themselves in a great majority of cases into two types—(1) the provision of labour; (2) the provision of transport for duties other than those for which the men, animals and vehicles are normally intended.

Men will be required to help out the provost units in traffic control duties, for stragglers' posts, for escorts for prisoners-of-war; others will be needed for working dumps of ammunition, engineer stores, water or petrol; again, they are needed for baths and laundries, and similar adjuncts to comfort and efficiency; they are also required for working tramways and other improvised transportation agencies.

Transport will be required for dumping ammunition, carrying up engineer stores, road repair material, and ordnance stores in excess of normal daily needs. The provision of this extra transport is not so difficult as might appear at first sight, so long as a sound system of centralized control of transport is established; there is no real difficulty in this under the comparatively static conditions of defensive operations. The administrative staff should prepare tabular statements showing clearly the work to be done in order of priority, the transport allotted for the purpose, the time and place where the transport is to report, and the unit or formation responsible in each case.

The detailed administrative work in retirements will be considered briefly under the separate headings of—Ammunition, Supplies, Medical Services, Ordnance Services, Provost Services and Reinforcements.

Ammunition.

The ideal to aim at is, whilst keeping all mobile echelons full, and the normal system of supply working throughout, to have on the ground at each successive position sufficient (but only sufficient) ammunition for use in that position. This can only be ensured by a perfect *automatic* working of the normal supply system, which depends for its success on an efficient communication by orderly from each rearward echelon to the echelons they supply. The importance of training and constant practice of this orderly system has already been referred to. It is not done in peace, because the ammunition echelons do not exist. It *must* be insisted on in war, or disaster is likely to happen should the occasion for retreat arise. So long as the ammunition sections of maintenance companies are in communication by orderly with ammunition companies of divisions, cavalry divisions and corps troops, and these in their turn are in communication with the batteries and infantry or cavalry brigade S.A.A. reserves, there should be no possibility of failure in ammunition supply from rear to front.

In a rapid retirement it is difficult to foresee in advance where battery wagon lines and infantry brigade S.A.A. reserves will move to. But if the *drill* of ammunition supply is insisted on, there should be no insurmountable difficulty in front of railhead.

In retreat ammunition once dumped cannot be picked up again; it can only be fired. As old-established railheads and advanced depots close the amount available from the rear tends to become much less, until the situation stabilizes again; economy is therefore essential, but the quicker the movement the less the expenditure.

The duty of the " Q " officer is to keep in touch with the situation and do everything in his power to help the maintenance of the routine drill of supply, by ordering moves in good time by selecting the best routes, by keeping people informed of what is happening, by keeping his head and working all out.

Supplies.

Supply companies—and the same applies to baggage—should be kept well out of the way until they are wanted ; a few extra miles are of little consequence for mechanical transport in such cases.

Move back the maintenance companies early to refilling points well in rear ; when unloaded, send them right back to the new railheads, then order back supply companies on to the refilling points.

Do not attempt to fix meeting points for lower formations on insufficient data, but do everything possible to ensure personal liaison between supply officers, R.A.S.C. and the formations to whom it is their duty to deliver. Ensure that all available information is passed rapidly and regularly to the O.C. R.A.S.C. of the formation concerned. Do not do the supply officer's work for him, but help him to do it himself.

The practice of dumping supplies on the side of the road, for troops to pick up as they fall back, should only be adopted in cases of gravest emergency ; it savours more of flight than of organized retreat, and may quite likely result in the unit going without its supplies.

Medical Services.

The evacuation of casualties during a retreat presents very considerable difficulty. In wars against uncivilized enemies it becomes a point of honour to bring in all wounded, and sometimes also the dead. This is really a tactical operation, the success of which may depend on rapid and vigorous local counter-attacks made with the one object of covering the evacuation of casualties.

Depth is of the utmost importance in the location of medical units during withdrawals ; another essential is the provision of a reserve of transport for evacuation purposes.

A casualty clearing station is at all times an immobile unit, and dressing stations formed by field ambulances in the areas of fighting formations are also temporarily immobilized while receiving and attending to wounded. There is little time for evacuation during the early stages ; a large proportion of ambulance personnel and transport will probably be required with the troops most closely in contact with the enemy.

The responsible medical officers must be kept fully informed of the tactical situation throughout the operation, and every possible assistance be given to them by way of additional transport.

Ordnance Services.

During a retreat there are apt to be large losses of kit and equipment, and replacements are difficult until the situation stabilizes. Units are not usually in a position to accept bulk issues of stores ; but the situation must be kept in hand and arrangements made to issue essentials in small lots at a time, capable of easy distribution to individuals. Transport is now provided in both second and third-line echelons for the carriage of ordnance stores, on a basis of nine tons weight per division and corresponding formations.

Provost Services.

From the point of view of traffic control on roads during a withdrawal, the situation presented by the handling of purely military traffic may well be full of difficulties ; these difficulties will be very seriously increased if the situation is complicated by the presence of large numbers of civilian refugees.

In such circumstances it will be necessary to reinforce the normal provost companies and squadrons, and for this purpose mounted men are by far the best. The

bottle-necks in the rearward routes must be appreciated well in advance, and strong measures taken to deal with them. It is best to concentrate attention on the most important points, provide them with strong traffic control posts, and supplement them by mounted patrols.

Whenever sufficient roads are available, which, however, will seldom be the case, it is advisable to allot separate routes for ambulances, and for tanks and mechanically-drawn artillery. In any case, provision must be made for units which move at widely differing speeds.

The command of traffic control posts and stragglers' posts, which themselves have to be withdrawn as a retreat proceeds, presents difficulties. Such posts are often distributed over a wide frontage, and there is little or no means of communication between them. Sometimes a time programme prepared in advance will meet the case, but there must be occasions, too, when such an arrangement is impracticable. Organization in depth and control in depth present the best solution, but there must be close co-operation with flank formations if success is to be obtained ; this means co-ordination by the staff of the higher formations.

The difficulty which arises in connection with stragglers' posts is the provision of the necessary personnel to man them. It will generally only be possible to concentrate on the main traffic routes, but this will depend to some extent on the general pace of movement. If the pace is sufficiently slow, stragglers' posts should be organized in three lines, the line nearest the enemy being manned by regimental police under brigade control ; the remaining lines being manned by personnel of provost companies, or specially detailed personnel under the D.A.P.M. A central collecting post for stragglers should then be formed, where they can be fed, if necessary re-equipped, and then be sent back to their units. An organization of this nature, however, presupposes a slow, premeditated and well-planned withdrawal.

Reinforcements.

The timely arrival of reinforcements during a withdrawal has a very good moral effect. But if units are not in a position to receive them and organize them properly into their various sub-units, their arrival may do more harm than good. In such cases the higher formations must be prepared to retain and to administer them until they can conveniently be absorbed by units.

The above remarks regarding administrative staff duties during retirement may now be summarized as follows :—

In an emergency stick to the normal system of maintenance as far as possible ; short cuts are generally dangerous.

Do not over-centralize, but ensure that tactical information is supplied regularly to administrative services and departments.

Plans and orders must be ready in advance for issue if and when the situation demands it.

Reconnaissance must be continuous and administrative units must be got on the move early.

Be prepared for sudden changes of direction and for other formations encroaching on your area.

The bulk of the administrative staff officers should be kept together, and in the closest touch with the operational branch of the staff.

Rapid decisions will have to be taken, and ignorance of what is going on causes confusion.

Diagram No. X illustrates (purely diagrammatically) the general layout of a divisional area in defence.

Diagram No. XI shows a form of march table which might be used for the withdrawal of administrative units and transport of a division in a retirement.

It will be noted that brigaded " B " echelon transport of infantry brigades have been included as units in this table. Normally it is desirable that this transport should move under the order of brigadiers of brigades as integral parts of their own brigade ; and when sufficient roads are available, this principle can be

adhered to in a withdrawal. It will often happen, however, especially in retirements, that it is essential to co-ordinate the movements of this transport with that of other units in the division, as, for example, when only one road is available at certain stages of the withdrawal; in such cases it may become necessary for its movements to be controlled by divisional headquarters. In retirements, too, it will generally be necessary for the areas which are ultimately to be occupied by this transport to be allotted by divisional headquarters, and their inclusion as units in the divisional march table facilitates this allotment.

CHAPTER VII

AN ADMINISTRATIVE STUDY OF THE PALESTINE CAMPAIGN.

EVERY theatre in which the various phases of the Great War were fought out presents its own particular lessons, whether of tactics, strategy or administration. Administratively, however, the campaigns in Mesopotamia and Palestine provide by far the most interesting lessons for the British soldier.

Though there is little doubt that the day will come when the British Army again goes to fight on the Continent of Europe, it is more likely to go first to fight in some theatre of the Near or Middle East. Although the broad administrative lessons of the war in France and Flanders are applicable in their main principles to any theatre of operations, Palestine and Mesopotamia present conditions affecting the maintenance of an army in the field which were not present in Western Europe; these are the conditions we shall have to contend with in our future wars, and the lessons to be learnt from them are all the more worthy of our study.

In the Palestine Campaign, deserts, morasses, hills, valleys, rocks and rugged mountains all had to be conquered; while climatic conditions included extremes of heat and cold, drought and torrential rain, and diseases such as malaria and ophthalmia were serious menaces to an army in the field.

In talking of Palestine there is a natural tendency to be Biblical, and conditions there prior to the war had not changed very greatly since Biblical days. Ever since the chariots of Pharaoh "drave heavily," the going in Egypt and Sinai has been difficult. We read how the children of Israel were compelled to make bricks without straw; similarly, the army in Palestine had

to struggle against a shortage of many essentials, especially as regards transport. We know how great were the difficulties of Moses in providing food and water for the children of Israel in the desert. The methods employed during the war by the Q.M.G. in Egypt to contend with this difficulty were little less wonderful than those adopted by Moses many centuries ago. If, however, a simile from lighter literature is preferred, it will be found in "Alice in Wonderland," for it is certain that the D.A. & Q.M.G. at Kantara, just like the Walrus and the Carpenter, must have "Wept like anything to see such quantities of sand."

But to get back to the administrative lessons of the campaign. It is in this campaign, perhaps, above all others included in the Great War, that we see the inter-dependence of tactics, strategy and administration and the preponderating influence of administrative considerations on the main plans of operations. Supply, in its widest sense, was a dominating factor throughout. Before discussing details in this connection, it will be well to consider a few points of geography and topography which have an important bearing on the subject.

First of all, we should remember that the Suez Canal itself has been cut through the desert, and it lies at least thirty miles from the inhabited part of Egypt. The towns on the banks of the canal—Ismailia, Suez, and Port Said—are entirely dependent for their water supply on the Sweet Water Canal, which flows one hundred miles from the Nile at Cairo before it reaches them. Furthermore, the Canal ports were only connected with Egypt proper by a single line of railway; it was not until the very end of 1915 that the line was doubled to Ismailia.

As regards Sinia itself, there were no roads for wheels anywhere, and water was very scanty except in winter. The armies of bygone days have used the coastal route across the north of the Sinai peninsula to invade Egypt from time immemorial, as there are wells along it and water can be obtained by digging. The water, however,

is both scanty and unpalatable, and does not suit the digestion of the modern European soldier—it is even too much for a railway engine's inside, and they declined to work on it. The line of communication offered by this coastal route is quite inadequate to maintain the needs of a modern army—these needs being so vast, so technical and so complicated in their nature in comparison with those of ancient days.

To make Lord Allenby's subsequent campaign in Palestine possible, the Kantara base was a necessity, as was also the bridging of the desert by the broad-gauge railway and the pipe line from the Sweet Water Canal to the frontier of Palestine.

As regards Palestine itself, once the Sinai deserts were crossed the few so-called roads were passable for all forms of mechanical transport until the rains came; then transport had to get along as best it could, sometimes taking days to perform journeys that should have been completed in hours. East of the Wadi Ghuzzee there was a belt of from twenty to thirty miles of cotton soil, which in wet weather became a bottomless quagmire, impassable equally by railway lines, camels or lorries, and diversions had to be made towards the edge of the sand country to avoid it.

The coast-line of Palestine and Syria is badly provided with harbours. From Port Said to Alexandretta the only intermediate port worthy of the name is Beirut; it is the only port that will take a ship of even 2,000 to 3,000 tons. On much of the coast line there is a considerable surf.

As regards climate, Palestine is notoriously malarious, and during the summer months localities such as the Jordan valley, the coastal plain, and the Vale of Esdraelon have the reputation of being barely habitable; even the hill country is by no means free. Very considerable organization was necessary to compete with the problem presented by the mosquito, and so long as the front remained comparatively stationary these efforts were most successful; but as soon as an advance

took place into areas where anti-mosquito work had not been undertaken, the daily sick rate rose from under 3 per cent. to over $5\frac{1}{2}$ per cent. When the final advance took place the problem of dealing with 100,000 prisoners, of whom more than 20,000 were sick with malaria or influenza, presented enormous difficulties for the medical authorities. Typhus, enteric, cholera and ophthalmia, which proved such enemies to Napoleon's troops in Egypt over a hundred years ago, were, however, most successfully kept in check in our army. The incinerator and the disinfectant certainly helped to win the war. Officers, other than those of the R.A.M.C., are sometimes inclined to question the necessity for the inclusion of a Hygiene Section in our war-time divisional organization. In Palestine they were absolutely essential, and they played a most important part in the success of the campaign.

These questions of geography, which have just been outlined, had very far-reaching effects on the administrative organization of the campaign, and should be borne in mind when considering the lines of communication at various stages during the operations.

The campaign was started for the defence of Egypt, with a main base at Alexandria. In these early stages the line of the canal was held by us. With the resources then available it was probably the only course possible for the time being. The Turk soon showed, however, that it was possible for him to cross the desert and attack the canal. This pointed to the necessity of establishing a line of defences farther east, so that the canal itself might be immune from long-range artillery fire. We were at the time acting purely on the defensive, so a line of strong posts and almost continuous entrenchments were laid out some eight to ten miles east of and parallel to the canal. To make this possible and to maintain the troops in this line, roads, railways and pipe lines were built out from the canal from eight or nine points, with an immense amount of labour and expenditure of material. Hundreds of miles of wire

roads were made by pegging down broad strips of wire netting across the sand; these were most successful for infantry, bicycles and Ford cars, though they were torn up immediately by mounted troops or ordinary touring cars.

The next step was the realization that, by occupying Rumani, we would hold the key to Sinai, owing to the existence of the wells at that point. By establishing a force there the long line of desert posts could be dispensed with. But to maintain a force at Rumani sufficiently strong for its defence necessitated the building of a railway and the laying of a pipe line, as British troops could not live on the Rumani well water. Luckily, standard gauge railway was decided on, as the narrow gauge, had it been laid, would never have been able to meet the subsequent requirements of the Palestine Campaign. Our force was established at Rumani. There the Turks attacked it and were defeated. Though the subsequent pursuit of the beaten Turk was brought to a standstill largely on account of exhaustion of our troops from lack of water, the battle marked the end of our purely defensive operations. From then on our object was no longer the defence of Egypt and the canal, but the defeat of the Turkish Army. From the defensive we passed to a very aggressive and mobile offence. This necessitated an entire upheaval of our administrative arrangements. A main base at Alexandria could no longer compete with the situation; it had to be reconstituted partly at Port Said, but mainly at Kantara. Kantara for the Palestine, and Basra for the Mesopotamian, campaign are two of the wonders of the war. Kantara at the beginning was a small village on the banks of the canal, consisting of a few mud huts and a mosque; it grew into an important railway terminus with forty miles of sidings, with wharves and cranes capable of dealing with an average of five ocean-going ships daily; it had thirty miles of first-class macadamized roads, vast depots for ordnance stores, supplies and engineer

stores also rest camps and depots for 120,000 men and thousands of animals. Here was established the main base for the Palestine force. The main ammunition base depot remained, however, at Alexandria, for the simple reason that it had got so dug in there in the early stages that it was subsequently impossible to move it with existing railway facilities. This was unfortunate, and it created difficulties, especially in the subsequent advance in Palestine.

Through the Kantara base went such volumes of supplies daily as 120 tons of meat, 250 tons of biscuits, 300 head of sheep and goats, 1,700 tons of forage, and 100,800 boxes of matches, to mention only a few items. This size of the base organization required by a modern army is colossal, for it must be remembered that the force to be maintained in Palestine was, at its greatest, under 500,000 men of all colours and 160,000 animals.

Of all physical obstacles to the advance of an army, deserts are probably the greatest. This arises, of course, from the water problem. Water was an ever-present difficulty throughout the campaign. In summer operations were liable to be prejudiced by a lack of water, in winter by an excess. On many occasions heavy rain jeopardized the supply arrangements, by converting the so-called roads into seas of liquid mud, rendering them almost impassable, and in places quite impassable, for either camels or mechanical transport. In many cases, too, the amount of water to be found in a given area, or the amount that could be carried there by pipe, camel or lorry, determined the size and composition of the force that could be employed in that area. In the early stages of the defence of Egypt and the canal it was perfectly clear that the only real defence—a defence, too, which made a change to the offensive possible—was to occupy the water-bearing country through which alone the Turks could advance. If it was denied to them they could not approach. Even in this area, however, it is doubtful whether European troops could have existed for long on such

water as there was. To take a large force there meant a pipe line and a standard gauge railway. Thus we find that, for the passage of the Sinai peninsula, the rate of progress was entirely dependent on the rate of advance of the railway and of the pipe line.

Later on the necessity for the capture of Beersheba as a preliminary to the attack on Gaza was largely determined by the necessity of securing the Beersheba water supply. The soldier administrator loves talking about "ration strengths," "fighting strengths" and "bayonet strengths," but in Palestine it was "drinking strengths" that mattered, and all sorts of adjustments in organization and breaking up of formations were resorted to in order to increase fire power without adding to drinking strength. As an instance of this there was the reinforcement of the mounted troops at Rumani by the machine gun companies of the 53rd and 54th Divisions, as there was not sufficient water there to maintain any more mounted troops. During the final advance it was generally possible to get enough water for the men to carry on with, but at many places the water was insufficient; even when water was found in sufficient quantities, it was usually in wells and not on the surface; consequently, if the machinery for working the wells was damaged, or a sufficiency of troughs was not available, the process of watering large numbers of animals was slow and difficult.

Water—or the lack of it—in fact, dictated the policy of defence and offence, and often of organization. The possibility of putting the policy into effect lay with the administrator and the engineer. Never since Sir John Forrest carried the waters of Perth, West Australia, three hundred miles to the gold-fields of Kalgoorlie have such gigantic schemes of water pipe systems been installed across a desert as carried the waters of the Nile to the borders of Palestine.

This water problem will face us in many places where we may find ourselves at war before so very long; no apology is necessary, therefore, for laying so much

emphasis on its importance. The means used for competing with the problem in Palestine will have to be used again, and an investigation of them will, in consequence, well repay the time spent in their study.

Before the pipe line from Kantara was laid down and supplying water, the army had started on its march forward, covering the railway construction parties, and water had to be carried forward in trains of water tanks.

These water trains were filled at special sidings, where twenty or more trucks could be dealt with simultaneously, and on arrival at railhead were emptied into a long row of canvas reservoirs laid beside the rails. Here small camel tanks, called fantasses, were filled up, and these were carried forward by camel convoys for distribution to troops beyond railhead. *fanata*

When the first section of the pipe line was completed, a new water siding was provided and the railway was relieved of carrying water for the first stage, and so on until water was finally pumped to railhead.

Once El Arish had been reached, the army passed into a country where, within limits, the troops could be supplied with water from local resources, though considerable organization was often necessary for improving watering facilities and in local storage and distribution. Many minor pipe systems were installed, and the railway became the chief consumer of the original pipe supply, large camel water convoys being employed in certain areas for distribution to the troops.

The Turks, in their retreat, might have made things much more difficult for us in the way of water than they actually did by destruction of wells and water-lifting appliances. In many cases wells had been prepared for demolition, but the charges had been left unfired.

We may now leave the question of water supply and pass on to a general consideration of the lines of communication.

Our lines of communication at the best were never good, as we were depending in the main on a single line

of railway, liable to interruption from sandstorms and wash-outs. In consequence, every subsidiary method of transportation that could be used was exploited to the utmost. From an administrative point of view the success of the campaign was largely due to the intensive employment of small ships of between 2,000 and 3,000 tons, and the landing of supplies and ammunition as and when opportunity offered, by means of surf boats and beach landings. The coast of Palestine and Syria, as already pointed out, does not, however, lend itself readily to this form of communication. Beach landings were, of course, very largely dependent on the weather and were precarious in consequence. The submarine menace, too, made the protection of the sea line of communication by no means easy. Though sea lines of communication were precarious on account of weather and submarines, land lines were likewise dependent on weather. The railways suffered during the rain from wash-outs and in dry weather from sand storms; the railway engines could not use the well water on account of its salinity, and, like the men and animals, were dependent on the pipe supply from Egypt.

To meet the interruptions which were liable at various stages on the lines of communication, all ships carrying supplies for beach landings had to be specially loaded so that any particular commodity could be got at quickly in the event of shortages arising from any interruption in land communication, and there were many anxious moments and cases of hand-to-mouth existence, especially when a submarine made a lucky bag on the subsidiary sea line of communications.

This campaign provides most interesting examples of various means of handling supplies between the base and the troops. As an example, in the final stage of the advance into Syria, the railway had been badly damaged by the Turks and many of the culverts destroyed and when we came to Haifa we found the big bridge between that place and Damascus had been blown up. Supplies from Egypt were conveyed to Haifa by sea, thence by

train from Haifa to the broken bridge, thence by mechanical transport, or camel in wet weather, across to the railway line again, thence rail to Damascus, thence by mechanical transport, camel and donkey in the hills, to the troops. The number of times supplies of all natures had to be handled in transit added much to the difficulty of maintenance. In the final stages of the advance, when supply by sea became possible to Haifa, Beirut, Tripolis and Alexandretta, as they successively came within the area occupied by the Egyptian Expeditionary Force, we find the curious but thoroughly economical phenomenon of important ordnance stores which had been collected in Palestine being sent all the way down the line again to Kantara for shipment to Syrian ports ; ordnance personnel being sent up to these ports as each new channel of supply was established. A similar policy was followed with the mobile workshops, which had to be kept as near the troops as practicable.

The difficulties, however, were by no means all on our side. If one examines the Turkish line of communication as it was in October, 1917, it will be seen that the maintenance of their force in Southern Palestine was no mean problem. From their main base at Haidar Pasha, opposite Constantinople, they were dependent on a single line of railway 1,275 miles long. This railway, in addition to maintaining the force in Palestine, had also to carry all stores for Mesopotamia as far as Muslimie, and also for the Hedjas force as far as Deraa. The Taurus and Amanus tunnels were at that time incomplete. It was not until October 9th, 1918, that the first broad gauge trains ran through the Taurus tunnel, and the first train to run direct from Constantinople to Aleppo arrived there only a few days before the city was occupied by our troops. Until these tunnels were completed, everything had to be unloaded at the western end and transported over the hills by pack transport and motor lorry, or had to be reloaded into narrow gauge trucks pulled by engines driven by compressed air, and

again reloaded at the eastern end of the tunnel. The Turks, too, were very short of rolling stock, and their engines were dependent on wood fuel, which had to be collected *en route*. In order to save rolling stock, reinforcements were often detrained at Rayak and marched from there to the front line, a distance of two hundred and fifty miles.

Before leaving the question of the lines of communication, it will be well to summarize the main points in this connection. The first is :—

That our main communications were liable to interruption, and therefore every means had to be employed to use subsidiary communications as opportunity offered. This applies especially to the last two phases of the campaign, in which sea communications enabled operations to be extended to a degree that would otherwise have been impossible. The next point to notice is the extraordinary diversity of transport used in the campaign, partly due to the urgent demands of other theatres, and partly to local conditions of climate and terrain.

What lessons do we get out of all this for our future wars? There is the lesson of the necessity for establishing advanced bases as our lines of communication extended, with their own sets of depots from which the continued maintenance of the fighting formations can be ensured during periods of interruption of the main lines of communication. This we see done in the Palestine campaign when we had the main base at Kantara, and advanced bases as the railheads advanced at El Arish, Rafa, Deir-el-Belah, Ludd, Jerusalem, Haifa, Beirut. The establishment of these advanced depots takes time; it often means considerable railway construction, and the stocking of the depots requires much transport. The time required for this will often decide the date by which further advance may be possible.

Now as regards the diversity of transport used. What ideas do we get in this connection, having in mind

the ever-increasing measure of mechanization now being applied to our Army ?

Since the war the tendency has been to eliminate animal transport and, where possible, to substitute mechanical transport. This is advisable for war in countries where sufficiently good road facilities exist, but we have not yet invented a mechanized camel, mule or donkey. Our liabilities are not confined to Western Europe, and the question is—Will our new organization meet all contingencies ? At certain times of the year—yes ; at other times, in certain theatres such as Palestine, Syria and Iraq—certainly no, for, in the words of the song—

“ How in the world can the old folks tell
It ain't a-goin' to rain no more ?”

Our organization should be sufficiently elastic to meet all possible contingencies. Is it ?

If we eliminate all animal transport we shall have no one trained in its management when the day comes to improvise it. Improvise it we certainly shall have to do in the future, as we have done in the past. It has been said that we are past masters in the art of improvisation, but we generally have had experienced men to make it ; in future it will not be too easy to do it by the light of nature unless we have some peace-time training in its management and some ideas as to how it has been organized in past campaigns. Mechanical transport has already reached a stage in its development that it can go practically anywhere that horse-drawn transport can go, but it cannot always go where pack transport can go. Pack transport work requires study, knowledge and practical experience if success is to be obtained. Where is this coming from when our army expands to a war footing ? The 30-cwt. lorry of to-day is ideal for our purpose as a load-carrying vehicle, but it cannot go everywhere. If a lorry of smaller capacity were used, we should intensify the difficulty of petrol supply ; transport columns would be extended to undue length, and the number of vehicles in use would be

multiplied, thus increasing the difficulties of providing drivers and spare parts and intensifying the problem of repair as well. Will our new organization suit the next war in China, on the North-East or North-West Frontier of India, in Afghanistan, Persia or Iraq? Remember always that the radius of action of a force in the field is limited by the possibility of maintenance. Distance and lack of transport facilities are the chief enemies in these countries, and it is the administrative staff officer who has to overcome them.

Let us consider a few examples from the Palestine campaign to illustrate this point. We will begin with the preparations for the first attack on Gaza.

By the middle of January, 1917, we had collected a force in the vicinity of El Arish, but for lack of transport were unable to maintain it much beyond that point. The camels then available were barely sufficient for first-line transport needs in the deep sand along the coast, and the railway was not yet across the Wadi. It was necessary to build up a supply depot at El Arish, and to collect and organize second-line transport before an advance was possible more than a day's march beyond railhead. Gaza was the objective, but it was fifty miles away, and therefore out of reach without transport. The decision was therefore made to advance on Gaza when the railway reached Rafa. The country would then admit of the use of wheeled transport to a limited extent, and the necessary supply echelons could then be formed to span the remaining twenty-five miles.

At this time very little mechanical transport was available, and the country where it could be employed had barely been reached.

For the advance on Gaza first, second and third line transport, consisting of camels, limbered G.S. wagons, and lorries and vans of various types were collected, and organized into fifteen divisional trains. Apart from the first line transport, the amount available only gave a total lift of 572 tons, an inadequate amount for a force of three divisions and two mounted divisions for even

one day. The operation therefore had to be a one-day show. The supply trains would admit of nothing more. If the coup did not come off, the troops must withdraw to be within reach of food and ammunition. If successful, there was water in Gaza, and supplies could be landed from the sea. As is well known, the attack was not successful, and the force withdrew.

Similarly, for the third Battle of Gaza everything depended on water and the provision of sufficient transport. The standard gauge railway was carried across the Wadi Ghuzzee at Shellal, the units of the XXI Corps in front of Gaza were stripped of their divisional transport, and a pipe-line was built from the Shellal reservoirs to the concentration area at Karms. By this means the XX Corps and the Desert Mounted Corps were given sufficient transport to enable them to move out twenty miles from railhead. About 30,000 camels were utilized for the task.

Subsequently the transport was turned over again to the XXI Corps for the pursuit ; the 54th Division was stripped of all its transport and left behind in Gaza with a dump of supplies to keep them going, for the fewer the troops to be maintained beyond railhead, the farther they could go.

Many similar instances of makeshift arrangements of transport, and of the dependence of tactics and strategy on administration, can be quoted from this campaign ; one more will suffice for purposes of illustration.

In January, 1918, the line Jerusalem—Jaffa had been gained by Sir Edmund Allenby's troops. The railway had reached a point about fifteen miles south of Ludd, and had not yet acquired great carrying capacity. The bridges on the railway line between Jaffa and Jerusalem had been destroyed by the Turks, and a great deal of work was required before this line could be put in working order again. To the task of maintaining his army was added the necessity of feeding the population of Jerusalem, consisting of some 80,000 persons, over a difficult mountain road. With the transport available

it was impossible to continue the advance chiefly, though not entirely, on account of the difficulty of maintaining supplies. The army had outrun its communications, and farther advance was impracticable until these communications could be got into proper working order and supply could be once more assured.

The instances quoted above are sufficient to show to what a very great extent the problems of supply and transport influenced the whole conduct of the campaign.

One more difficulty, which has already been mentioned, calls for some further notice—that was the problem of dealing with the very large number of prisoners captured during the final stages of the advance. In some instances they were captured fifty to sixty miles in front of railhead, and they had to be marched down, watered and fed on the way, until they reached their base destinations. There were between 80,000 and 100,000 to be dealt with, and many of them were in a state of exhaustion or were actually medical cases, which added to the difficulty. Camps and hospitals had to be provided for them. Concurrently with this came the influenza outbreak of 1918, which threw an unprecedented strain on the medical organization and on the ordnance service in providing the necessary accommodation for our sick as well as for the prisoners-of-war. This is a type of difficulty we may meet again in campaigns fought under somewhat similar conditions.

There is nothing really new in the nature of the administrative problems of the Palestine campaign. Similar difficulties have been met and overcome in the past. History is certain to repeat itself, and we shall have to do it again in our future wars. The more we study the problems, the easier their solution will become. In Palestine, owing to the demands of other theatres and the difficulties created by submarines, there was always a shortage—calling for the production of bricks without straw—and nearly always the chief difficulty was lack of sufficient transport. It was the

same really in other theatres, though possibly less so in France. It is the same old lesson over again that every war has taught from the beginning of time. The great strategical movements of armies have depended always upon their means of obtaining food and warlike supplies. Or as Napoleon put it: "Le secret de la guerre est dans le secret des communications."

CHAPTER VIII

WAR EXHAUSTION.

IN Field Service Regulations we read as follows :—
“ War can be brought to a successful conclusion only by the defeat of the enemy’s armed forces and the destruction of his power of resistance. The object to be aimed at in designing an Imperial Army is to produce an organization which can achieve this result in the minimum of time, with the minimum expenditure of men, money and material. One of the basic principles of war organization is to economize military force by utilizing to the greatest extent possible the ordinary machinery of civil life to assist the forces in the field.”

The art of war is to expend our enemy’s resources while conserving our own. Strategically, tactically and administratively, we must apply the principle of economy of force so as to prevent war exhaustion in our own nation while compelling it in that of the enemy.

War of the continental type is no longer the affair of the fighting services alone ; every department of State, every man and woman, is affected. Every citizen must be prepared to play his or her part in the defence of the nation’s vital interests : as soldiers we endeavour to do this by the destruction of the enemy’s powers of resistance ; as responsible officers we should endeavour to educate our civilian brothers in their duties in this connection, so that our national machinery may be so organized as best to conserve our military resources.

It would hardly be possible, short of a book of many pages, to give a comprehensive list of the items which can legitimately be classed as war matériel. Such a list would vary from the obvious items like guns and ammunition to the less obvious, though possibly vital, commodities such as jute and shellac, which, as pointed

out in Chapter V, can only be obtained in bulk from India.

Of all the requirements of war, man power is the first and most important. Even when we arrive at the days of the death-ray we shall require men to make the appliances, or produce the plant and power for its manufacture and projection. The exhaustion of man power is therefore our first consideration, but the exhaustion of matériel is a very good second, as men alone without the means of feeding and fighting would not go far towards winning the war.

We need to organize our man power in peace and to conserve it in war; similarly we must organize and protect our material resources so as to prevent their premature exhaustion in war. Men and matériel are both essential, but without a determination to win in the civil population as a whole, the big wars of the future will not be brought to a successful conclusion. The tendency of modern war is to bring the importance of this last factor into greater prominence than ever before.

In considering the problems of war exhaustion in their application to continental wars of the first magnitude, there are therefore these three main factors to be dealt with :—

- (a) Exhaustion of man power.
- (b) Exhaustion of war matériel.
- (c) Exhaustion of the determination of the civil authorities.

Each of these headings will now be discussed in turn in the light of the more recent requirements of modern warfare.

Unlike the great continental nations, with their compulsory service systems, we have no general registration of our man power. We do not really know the numbers and distribution of our available resources of men physically fit to fight. Still less can we readily lay our hands in time of need on the very large numbers of

skilled tradesmen of innumerable grades and types required for the maintenance of our armies. Short of a change in our national psychology and of our constitutional laws, it is hard to see how this difficulty can be overcome. At the beginning of the Great War, and, indeed, at all stages during it, our first need was men, and we have every right to congratulate ourselves on the magnificent response of the nation to the first calls for volunteers to fight. On August 6th, 1914, 100,000 men were asked for; by August 25th this number had been practically secured. Although the total had to be multiplied eventually by ninety, the response of the nation was really magnificent. The very magnificence of this response was, however, partly the cause of our subsequent difficulties as regards man power, especially in connection with munitions supplies.

The skilled employees of the armament firms and likewise of the building and allied trades enlisted in large numbers. The result of this was to reduce the munitions output by about half of what had been anticipated, and to make it impossible to start on the necessary extensions of the firms' premises.

If we consider the situation at the beginning of the war, we find the recruiting officers, under the orders of the Adjutant-General, making every effort throughout the country to enlist men to serve with the colours, while similar organizations were at work recruiting for the Navy and the Royal Flying Corps, as it then was. The Master-General of Ordnance was applying to the Board of Trade for skilled workmen required for munitions work, while the Board of Trade was primarily concerned in the maintenance of the country's commercial enterprise so that our export trade should be in a position to maintain our credit overseas. Men were required for the fighting forces and for munitions work; to maintain them, industry, in turn, had to be kept going. No authority existed, until the Military Service Act was passed, under which our man power could be controlled or directed into the channel most

essential for the country's need. The various agencies at work were in many ways competing with one another, and thereby adding to the nation's difficulties, and no man could be compelled to serve with the colours or to work at munitions provision. The only way to deal with the situation was to have one authority dealing with the provision of personnel to meet all the nation's needs, whether for Navy, Army, Air Force or Industry.

The lesson is that for war on a grand continental scale we must have a National Service Act, and still more in peace do we require a National Registration Act, without which we have no means of gauging the nation's potentialities in skilled workers of any grade or of knowing where we can lay hands on them in time of need.

Whether or not the nation is prepared to accept legislation to this end, is not for the soldier to say ; but one thing is clear—that for a great war we must have government control of labour and its movements, and, just as before the war Lord Roberts preached National Service, so should every soldier to-day preach National Registration.

So much for the question of provision of man power ; it is a problem primarily for the statesman. As soldiers we are more directly concerned in preventing the wastage in war of the man power placed at our disposal by the efforts of the Adjutant-General's department.

In battle we aim at reducing our casualties from the enemy's shells and bullets by adopting the most suitable tactics, and by improving the co-operation of all arms so that we can attain our object with the minimum of losses. In peace, too, we study the principles of sanitation and hygiene so that we can apply them in the field to the prevention of casualties from disease, which in the past have proved such a serious drain on our armies in war. In future, as the result of our experiences in the Great War, we must study the causes and means of prevention of psycho-neurosis—more commonly, if erroneously, called shell-shock—as

this disease was responsible for very serious wastage of man power in the last war.

Our actual losses from psycho-neurosis during the war were certainly very heavy. At the time of the Armistice no less than 65,000 soldiers were in receipt of pensions from this cause alone. Of the total number of cases of psycho-neurosis which occurred, it was calculated that 90 per cent. were not due to actual shock of shell explosion or physical wounds, but were due to a mental state brought about in the individual by the conditions of existence and prolonged strain to which they had been subjected under the circumstances of modern war as we knew it between 1914 and 1918.

In addition to the numbers who were actually evacuated from this cause, there must have been many whose fighting efficiency was considerably impaired, although they may not have reported sick. Here, then, is a very definite form of war exhaustion, and it is one which all officers can do a very great deal to minimize or prevent.

Since the war this disease has been the subject of close inquiry, and the "Report of the War Office Committee on Shell Shock" contains a lot of most interesting evidence from commanding officers, staff officers and medical officers which will well repay the time taken in reading it. The burden of the conclusions come to by this committee may be very briefly summarized, for our present purpose, as follows :—

- (a) Psycho-neurosis is a definite disease, which in certain circumstances is contagious, resulting possibly in panic or in desertion to the enemy in serious proportions.
- (b) High morale and good leadership undoubtedly tend to lessen the condition if not to prevent it altogether. When discipline is bad you get desertion, where there is no *esprit de corps* you get cowardice; where you have a high standard of *esprit de corps* and discipline you

do not find these things and you get very little shell-shock.

(c) To prevent psycho-neurosis, therefore, we must first of all promote good morale, and back this up by good interior economy and good administration in units. When the conditions of active service admit good food, rest, exercise, baths, clean clothes, entertainments and leave, are potent factors in preventing psycho-neurosis. Good sanitation and the physical comfort of the men must have our constant attention, as they very considerably affect the incidence of shell-shock.

(d) Though a good regimental medical officer is of the highest possible value in this connection, it is the unit regimental officer who really tells and who can do most to prevent war exhaustion from this cause. It must, however, be realized that the requirements of modern war are nations in arms, and as our expansion for war increases the recruiting net is cast wider and wider. We must then take in a type of man whom we would reject for military service in normal times. It is then that this question of psycho-neurosis assumes serious proportions. We should be able to eliminate it entirely in a highly trained voluntarily recruited peace-time army.

Let us turn now to the second heading—the exhaustion of war matériel. No country in the world is entirely self-supporting as regards all its raw material for war. The United States are probably better off than most, but even in their case there is quite a formidable list of items to be obtained from other countries. What we have to consider is how we are going to prevent the exhaustion in war of our essential material needs, and how we can best turn the question of the war exhaustion of an enemy's material resources to our own advantage.

The answer to the second question is found in the application of the blockade, of which no better example can be found than the blockade of the Central Powers during the Great War. There are, of course, many serious difficulties in applying a blockade effectively, difficulties arising out of the rights and privileges of neutrals, which will often present most delicate and complicated problems in international diplomacy. But the war taught us how vital the supply of such things as cotton, nitre, fats, rubber and such-like commercial items are to a nation engaged in war, and the weapon of the blockade is one that we as a nation cannot afford to dispense with in a continental war.

The solution of the problem of how to prevent exhaustion of our own raw materials is much more difficult. The two outstanding factors in this connection are finance and time—finance which precludes the holding of vast reserves in peace against possible war eventualities ; time since, when mobilization is ordered, large stocks of every kind of need are called for faster than they can possibly be produced or imported from outside. As an example in connection with the time factor, it is interesting to note that one item which seriously delayed the equipment of our new armies in 1914 was a complete failure of the trade to supply sufficient buttons !

The subject of peace-time reserves and the problems of munition supply in war have been dealt with in an earlier chapter, both from the point of view of time and of finance ; and it has been pointed out that finance prevents adequate peace-time provision being made against exhaustion of our material resources in war, while time is the chief obstacle to overcome in creating the necessary reserves when war had begun.

Though we are very far from being self-supporting in this country, we are very nearly self-supporting within the Empire, and this aspect of the war exhaustion problem needs consideration and further development. This is not purely a matter for the civilian and the

politician ; the fighting services must give voice to their needs. We must ask for what we want, and keep on asking, for in proportion as this provision is not made will future generations groan under still heavier taxation after the next war.

It will be as well to consider at this stage how the problem of war exhaustion is affected by the mechanization which is gradually being applied to the Army to-day.

All the leading nations are now busy mechanizing their armies, and most of them have or are thinking of starting tanks. Could we not as an industrial and commercial nation aim at becoming the supplier of tanks to the smaller nations, and thus establish a peace-time industry which could be developed in time of war to meet the requirements of our army ? The existence of such an industry would prove of the highest war-time value to any country possessing it.

To take another item : the 30-cwt. lorry carries approximately the same load as the old G.S. wagon ; both require one man to drive and look after them. The 30-cwt. lorry has increased speed and radius of action ; but the average life of the lorry is two years, personnel for repairs and maintenance are required in the theatre of war on the basis of one man to every three vehicles, and what of personnel for production of new lorries and spare parts ? With this mechanization you get increased efficiency, but you pay the price in men.

The mechanized armies of the future must be prepared to make extensive replacements of lost and damaged equipment at an early stage in the operations, or they will be seriously handicapped in retaining their essential mobility.

We must decide on our military requirements, and we must aim at developing our industrial resources on the lines of these war-time needs ; this development must keep pace with our application of mechanization to the army, or there will be danger of war exhaustion overtaking us from our very mechanization.

The possibility of chemical warfare presents further problems in connection with war exhaustion.

Most nations, but not all, have agreed not to use gas in war, but we cannot tell yet with whom we may have to fight next. The use of gas may be forced upon us if our enemy first uses it against us. We must remember, too, that gas, or the fear of a gas, is a potent factor in producing shell shock. We can take defensive measures by way of the provision of gas masks for our fighting personnel; and we can organize defensive measures and decontamination parties for our towns and villages which are open to attack with gas from aeroplanes; but offensive organization is more difficult. We are now, as a nation, much better off than we were before the war in this respect. But for war purposes, if gas was to be used, we would need to expand our chemical industry very considerably; we should be compelled, too, to mobilize our chemical engineers and organize the work of our by-product coke ovens. In this respect, as in the others already mentioned, the soldier in peace must study what his possible requirements may be in war; he must be ready to tell industry exactly what these requirements are, and our Government organization must then see that industry can meet the nation's military needs.

It is clear from the few examples quoted that the developments of modern war have made the problem of war exhaustion of much greater importance than it ever was in the past. The whole resources of the nation are now required and the rapidity and effectiveness with which industry can be organized to meet the emergency cannot but have an enormous influence upon the issue of the struggle.

The soldiers' peace-time duty in connection with industry has been touched upon, also his duty in peace and war in connection with discipline, interior economy, and the inculcation of morale as a means of preventing psycho-neurosis. There is another war-time duty of considerable importance in connection with the preven-

tion of exhaustion of war matériel, and that is salvage. A good salvage organization can do much to prevent unnecessary and avoidable waste. If the statistics of the war are studied it will be found that literally millions of pounds sterling were saved by salvage operations. The reconditioning of abandoned clothing and equipment, the production of by-products from messing and from fat eliminating plants, and the organized clearing of battlefields resulted in truly enormous savings. The loss of equipment by careless soldiers; the dumping of unnecessary quantities of ammunition in places from which it could not readily be collected again, or where it would deteriorate; the breakdown of lorries from overloading or bad handling; the loss of horseflesh from bad horse management, are all questions which, if neglected, have a big cumulative effect towards the production of war exhaustion, and they are all matters which can be lessened by care, forethought, and energy on the part of staff and regimental officers. Salvage is a question of organization for its collection, prevention of waste is a matter of discipline.

Painted on walls and houses in the battle areas of France and Belgium may still be seen the words: "What have you salvaged to-day?" This was a necessary reminder in the days between 1914 and 1918; it will be equally necessary in the next war as one means towards the prevention of war exhaustion.

Coming now to the question of exhaustion of the determination of the civil authorities. General Ironside reminds us in his book on Tannenberg that "Military thought cannot afford to ignore the ordinary feelings of human nature," and he also states that "the great fault of the German General Staff throughout the war was that it placed itself apart from the German people and ignored their feelings." We must be careful not to make the same mistake. The psychology of the British race is such that in time of peace or fancied security it is peculiarly averse to taking any military precautions and very unwilling to pay the premium

necessary as an insurance against the possibilities of war. When once convinced that the real emergency has arisen, it comes forward magnificently to fight in defence of its country. Modern war is now an affair of nations, and on the European scale future wars will not be brought to an end until all the resources of one side or the other have been exhausted. It is above all necessary, for the successful conclusion of a big war, that the determination to win of the civil population should be maintained.

War weariness of the nation may be brought about by blockade, by unrestricted submarine warfare, by air attack on civil centres of industry and these forms of warfare are likely to take a more prominent part in future wars than in the past. As soldiers and citizens we have to play our part in preventing the exhaustion of the nation's determination.

Much can be done by way of propaganda now and every day in peace to stimulate the morale of the nation and the nation's pride in its armed forces. Military tournaments, torchlight tattoos, naval reviews and air force pageants are all valuable means to this end. The British Legion, the Boy Scouts, Girl Guides and similar organizations, are of the highest possible value in this connection, and it is our duty as soldiers to give them every possible help and encouragement as opportunity offers. The soldier should be continually at work educating his civilian brother in the nation's military needs. National registration is our first requirement, industrial organization to meet war-time necessities is the next.

In preparation for both of these the soldier must play his part, as he will be the first and greatest sufferer if exhaustion should overtake us in the next great war.

APPENDIX 6

SOME NOTES IN CONNECTION WITH PETROL SUPPLY
IN WAR.

1. Weights and Measures.

- 1 2-gallon tin of petrol, full, weighs 18 lbs.
- 1 2-gallon petrol tin, empty, weighs $5\frac{1}{2}$ lbs.
- 1 case of petrol holding 4 full tins (8 galls.) weighs 100 lbs.
- 22 cases of 176 gallons equals 1 ton gross weight.
- 1 Medium 6-wheeled lorry carries 350 cans, equivalent to 2 tons 8 cwt.
- 1 Light 6-wheeled lorry carries 175 cans, equivalent to 1 ton 4 cwt.
- 1 G.S. trailer carries 16 cases (128 gallons).
- 1 gallon of petrol (bulk supply) weighs 7 lbs. 4 ozs.
- 1 10-ton covered railway goods wagon can carry 1,280 gallons in tins in cases.

2. Circuit of Action with Amount of Petrol Normally Carried in War.

Heavy lorry	...	...	...	...	91 miles
Light lorry	...	...	...	...	144 „
Motor vans	...	...	...	...	108 „
Motor ambulance—Heavy	...	...	...	...	108 „
Light	...	...	...	...	150 „
Light Tank—By road	...	...	...	...	180 „
Cross country	...	...	...	...	145 „
Dragon—Mk. II	...	...	...	...	69 „
Mk. III	...	...	...	...	46 „
Rolls, Armoured Car	...	...	...	...	150—160 „

3. Types of Petrol Required.

- (a) M.T. petrol all ordinary purposes.
 - (b) Mixture 75% Grade 1, 25% Benzole for tanks and dragons.
 - (c) Aviation spirit for R.A.F.
- All above must be stored and carried separately.

4. Bulk Supply Notes.

At the beginning of a war the petrol supply will be in tins.

When bulk installations are ready and the necessary road and rail vehicles are available, the supply will become mainly a bulk supply. Certain units will always remain on tin basis. Ultimately about 75% will be bulk and 25% tins.

5. Quantities Required.

(a) One infantry division requires daily from 10 to 14 tons weight of petrol in tins. The exact amount will depend on the nature of operations in progress.

(b) For large forces (five divisions or more) with cavalry, non-divisional, and L. of C. troops and R.A.F. in proportion from 60 to 100 tons weight of petrol in tins per division in the force will be required for all purposes. This calculation is made on the basis of the number of infantry divisions in the force, the figure given being sufficient to meet all requirements.

This represents a daily consumption of from 15,000 to 25,000 gallons per division for all services, including R.A.F.

APPENDIX 7

SUMMARY OF INFORMATION REQUIRED BY ADMINISTRATIVE STAFF OFFICERS.

Ammunition.

Know the normal system.

Know the different natures and their component parts.

Know the use of the various natures.

Know methods of packing and amounts carried in echelons.

Know what supplies are available in reserve.

Accommodation.

Practice an eye for country and an eye for town, to know at a glance the accommodation facilities of an area, and know the requirements of staging areas and rest areas, and particulars of any that are established permanently.

Engineer Stores.

Know normal system of supply.
 Know what is carried by formations and where.
 Know requirements for hutting and water points.

Interior Economy.

Know how units can be helped; they do not always know themselves.

Movements.

Know the details of every type of move—tactical train, strategical train, bus, march; and know the transportation facilities available.

Ordnance.

Know the normal system of supply.
 Know the types and capabilities of the various sorts of workshops.
 Know what is in depots, gun parks and other stores.

Remounts.

Know the normal system of supply.
 Know the requirements of formations.

Supplies.

Know the normal system.
 Know the possibilities for juggling and saving during stationary periods.
 Know where personnel comes from for handling supplies at various stages.

Transport.

Know the capabilities and limitations of H.T. and M.T. and loads.

Know the nature of harness in use (P.D. and others).
Know repair facilities of units and formations—
tyre presses and mobile shops.

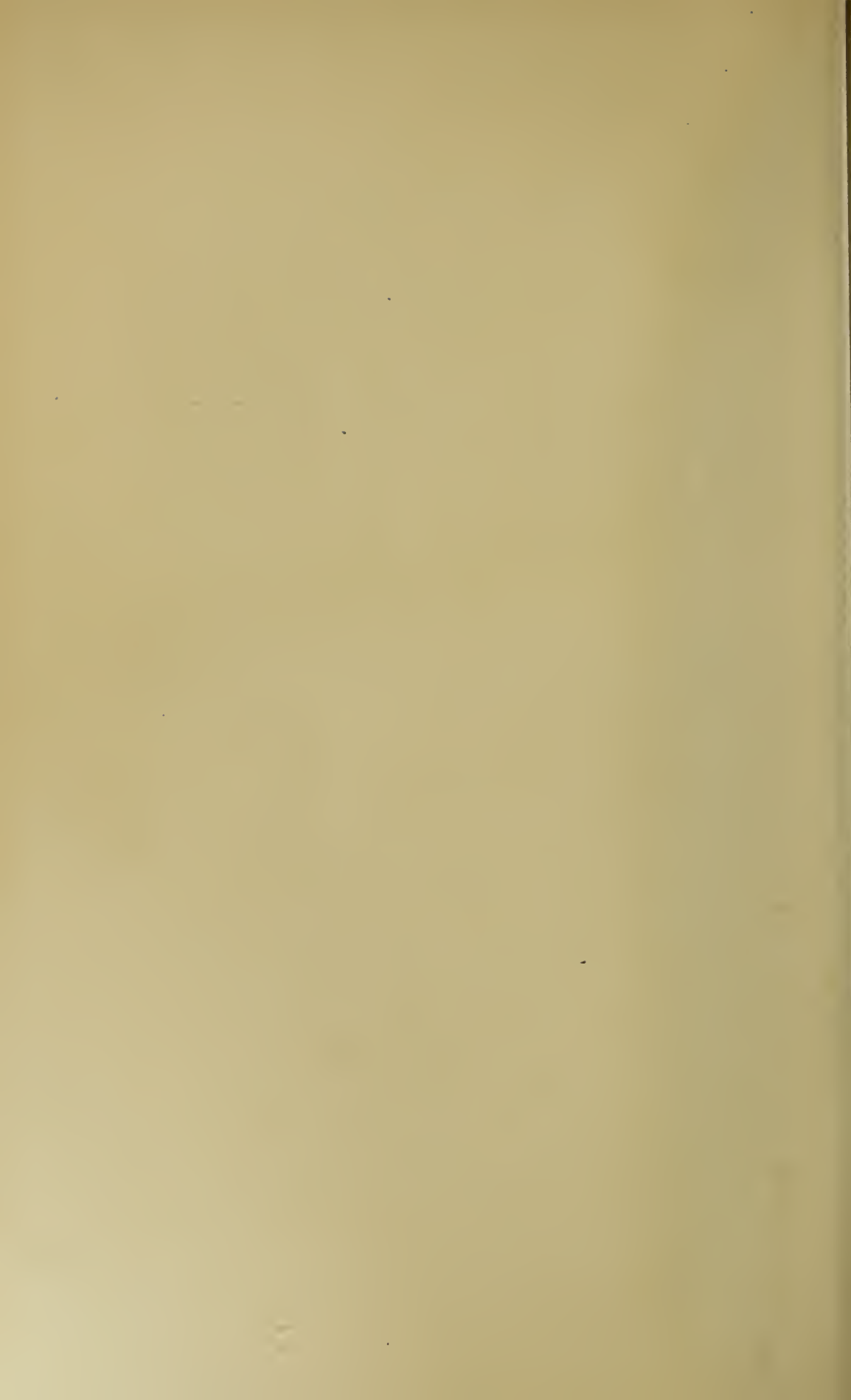
Veterinary.

Know the capabilities of units and the normal
system of evacuation.

Railheads.

Know all about them—and what they can handle.





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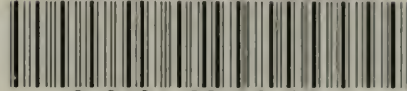
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